2014 North Carolina A&T State University and North Carolina State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

In North Carolina, a range of research and extension efforts are designed to better the lives of North Carolinians and make the state a better place in which to live. These efforts are the result of work at two institutions: North Carolina State University (NCSU) and North Carolina A&T State University (NCA&T). This report documents 2014 research and extension programs provided by these two universities. Research and extension programs at the two institutions are housed largely in the College of Agriculture and Life Sciences (CALS) at NCSU and in the School of Agriculture and Environmental Sciences (SAES) at NCA&T.
The North Carolina Agricultural Research Service (NCARS) is the research arm within CALS at NCSU, while research at NCA&T is conducted through the Agricultural Research Program (ARP) within SAES. At both institutions, the research effort serves interests in agriculture, environmental, and biological or life sciences. In addition, research programs provide the scientific base for academic and extension programs delivered by the two universities.
The creation of a new College of Sciences (COS) at NCSU in 2013 had significant impact on CALS. A number of CALS faculty members, notably those in biological sciences, microbiology, toxicology and genetics, moved to COS along with roughly half the CALS student population. The transition is complete, and the college has embarked on a new strategic plan (launched in 2013) focused on people, partnerships and programs. The plan, which outlines strengths, priorities, and opportunities for long-term growth and success, is built upon five core strategic themes:
1. Enhancing the production, quality, accessibility and profitability of food, plant, animal and bioenergy products for North Carolina, the nation and the world;
2. Ensuring environmental stewardship and sustainability of air, land, soil and water resources;
3. Creating a food supply that is safe, secure, healthy, affordable and of high quality;
4. Improving human health and well-being for individuals, families and communities; and
5. Preparing students and stakeholders for leadership and success in the global workforce.
Throughout 2014, the college strengthened relationships with commodity groups statewide and built a significant support base for two major initiatives:
1. **The Plant Sciences Initiative** is based on an interdisciplinary systems approach. North Carolina's largest agriculture and biosciences assets will be concentrated in a new world-class interdisciplinary research complex on the NCSU campus. Efforts are underway to raise $180 million to build the Plant Sciences Research Complex and establish North Carolina as the world leader in plant sciences research and innovation. The research that will be conducted at this site will lead to increased crop yields, nutrition diversification, sustainable production methods, and extended growing seasons.
2. **The North Carolina Food Processing Initiative** will diversify and add value to agricultural-based businesses through food processing. Funded in 2014 by the North Carolina General Assembly, the initiative is designed to help expand the economic impact of agriculture and agribusiness in our state by 22 percent - to $100 billion - by 2025. Increases in food and beverage manufacturing - entirely possible given North Carolina's highly diverse variety of crops, livestock, soils and climate - will be the cornerstone of this initiative.
The college's research arm, NCARS, conducts research at facilities on and off the NCSU campus. On-campus facilities include highly specialized laboratories (i.e., molecular imaging, soil analysis, and x-ray

crystallography), greenhouses, the Phytotron controlled environment facility, the Biological Resources Center small animal facility, Pesticide Residue Laboratories, the Animal and Poultry Waste Management Center, Feed Mill, Structural Pest Training Center, Genomic Sciences Laboratory, Plant Transformation Laboratory, Bioinformatics Research Center, Food Rheology Lab, Nuclear Magnetic Resonance Facility, Plant Disease and Insect Clinic and Food Processing Pilot Plants. Off-campus facilities include 10 field laboratories with extensive animal and crop research capability and facilities for agricultural and municipal waste management research; regional research and extension centers with resident research and extension faculty in both western and eastern North Carolina; and 18 agricultural research stations strategically located throughout the state, including the Center for Environmental Farming Systems in Goldsboro, NC, which specializes in sustainable agriculture research and extension.

During the reporting period, the Agricultural Program at NCA&T made significant contributions to agricultural research in all of NIFA's eight research priority areas. Much of NCA&T's research activity is sponsored by the U.S. Department of Agriculture. Research is conducted on the university farm, the Center for Environmental Farming Systems, the Center for Post-Harvest Technologies at Kannapolis, N.C., and in on-campus laboratories, where investigations include such disciplines as agricultural economics, animal science, plant science, landscape architecture and design, human nutrition, housing, food science, and animal health.

The knowledge and technology developed through research conducted in NCARS and ARP are made available to North Carolina citizens through the North Carolina Cooperative Extension. Both the College of Agriculture and Life Sciences and School of Agriculture and Environmental Sciences work collaboratively to provide educational opportunities that are relevant and responsive to the needs of individuals, communities, counties, and the state. North Carolina Cooperative Extension is at the heart of this partnership and is the principal agency providing these educational opportunities.

Cooperative Extension's mission is to help people put research-based knowledge and technology to work to foster economic prosperity, environmental stewardship, and improve quality of life. To achieve this mission, Extension specialists and researchers at the two land-grant universities work hand-in-hand with field faculty stationed in all 100 North Carolina counties and on the Cherokee Reservation in the state. To achieve relevance and value in its programs, Extension benefits from the input of a well-established statewide system of lay advisers, who represent the state's diverse population. Each county periodically conducts an environmental scan to determine emerging needs and appropriate educational responses. These scans give residents, advisers, commodity group representatives, volunteers, and other clients an opportunity to ensure that local programs meet local needs and priorities. Cooperative Extension also maintains a civil rights plan that includes computer monitoring of program participation by gender and race. This effort ensures that underserved and underrepresented audiences are among those included in program development and implementation. A permanent Diversity Task Force monitors programs, suggests policy, and develops and conducts training for the organization. Stakeholder input informs all Extension programs.

In 2014, NCSU Cooperative Extension completed development of a strategic plan for restructuring the century-old organization. The plan is designed to target Extension' strengths, improve access to services across the state and refocus resources to support its refined core program areas: agriculture, food and 4-H youth development.

The organization is focusing its resources where it is most needed, best equipped to provide solutions and can make the greatest impacts on North Carolina's communities and economy. Each core program area will include multiple sub-programs, and volunteer-driven programs like Extension Master Gardener also will continue to be an integral part of Extension. The strategic plan roll-out will involve significant structure and staffing changes in order to optimize service access throughout North Carolina. Tactics include: increase investment in technology, expand communication and branding efforts, strengthen capacity and collaboration, and enhance staff retention and expertise. Implementation of the strategic plan is expected to be complete by July 2016.

This report reflects impacts of the joint educational programming efforts of the NC Cooperative Extension Service of NCSU and the Cooperative Extension Program of NCA&T. This report also updates and highlights accomplishments and impacts of research conducted through NCARS and ARP, emphasizing

high-priority areas in agriculture and life sciences for North Carolina now and in the near future. The research and extension programs documented here are helping North Carolina's population of nearly 10 million citizens address critical challenges facing them today and in the future.
Following are examples of research and extension activities from both NCSU and NCA&T within each program area.

PLANNED PROGRAM #1

GLOBAL FOOD SECURITY - PLANT PRODUCTION SYSTEMS AND HEALTH

North Carolina sweet potatoes continue to dominate, thanks to NCSU variety development: The 1.58 billion pounds of sweet potatoes produced in North Carolina account for roughly 50 percent of the nation's supply in 2014. NCSU has developed what is considered by some to be the world's premiere sweet potato breeding program, enhanced by a grower-participatory breeding project that is a long-term partnership between researchers, Extension agents and sweet potato farmers. NCSU variety 'Covington,' which accounts for 90% of the North Carolina sweet potato crop and about 40% of the U.S. sweet potato crop, brought in $206 million in 2014. Such success has also seeded future progress by attracting significant grant funding from the Bill & Melinda Gates Foundation for a project focused on developing next generation genomic, genetic and bioinformatics tools to facilitate sweet potato improvement in sub-Saharan Africa.

Cowpea variety testing leads to new knowledge of how (and where) best to grow this important crop: Many farm families depend on their farm enterprises as the primary source of food and income. Small farmers account for 90% of all farmers in North Carolina. A majority of them grow cowpeas, also known in the U.S. as southern pea, Crowder pea, and black-eyed pea. A major limitation to expansion in production is the devastation by pests and diseases. Forty-eight cowpea varieties were evaluated for various traits (including reaction to pests and disease, potential for nodulation and use as forage and cover crop) at the two major ecological zones in N.C.: the Coastal Plains and the Piedmont where the crop is mostly grown. Analysis revealed major insect pest observance of the invasive brown marmorated stink bug (BMSB) in Greensboro (Piedmont) with high populations (5.5 bugs/plant) but in Goldsboro (Coastal Plains) the highest BMSB count was only 0.13 bugs/plant. Although cowpea did not suffer significant damage from BMSBs in Goldsboro, another important insect pest, the cowpea curculio (Chalcodermus aeneus Boh.) caused severe damage (16-62% seed damage) at that location with relatively low (0.93 - 21%) seed damage in Greensboro. Future work will determine the underlying factors responsible for this dichotomy.

Production of wild harvested ginseng could yield big profits for N.C. farmers: In 2013, prices for wild harvested ginseng reached record high of $1,200 per dried pound. Watauga County has ideal growing conditions for ginseng, and landowners are interested in cultivating ginseng in "wild-simulated" conditions to produce income from their forestlands. Cooperative Extension held a ginseng planting workshop and made individual farm visits to demonstration the proper soil fertility amendments and establishment and maintenance practices for ginseng production. Eight growers successfully planted 1,000 pounds of ginseng seed during the fall of 2014. Harvest of seed, rootlets and berries should conservatively yield more than $1 million to these producers in 4-8 years.

Managed growing settings may improve re-growth of overharvested medicinal plants: Medicinal plants such as black cohosh and goldenseal are being overharvested from the wild. Re-growth of such plants is slow and difficult to meet high and constant market demand. To reduce their depletion from their natural settings a program has been implemented to produce these plants in managed growing settings. Researchers at NCA&T are growing medicinal plants in local woodland and high tunnel/greenhouse settings to determine optimal shade and other growing conditions. Seedlings will be selected for maximal shoot initiation and proliferation in laboratory micropropagation studies.

Transitions in the N.C. tobacco industry leads to economic development opportunities for other crops: In collaboration with Universal Corporation consultants, NCSU scientists developed an innovative new procedure to process sweet potatoes that are sound and wholesome but currently have been unused due to surface defects and less desirable shapes and sizes that don't affect their nutritional assets. In 2014, Carolina Innovative Food Ingredients Inc. broke ground for a $20 million sweet potato processing facility near Nashville, N.C., that will use the NCSU research to process sweet potatoes into value-added,

high-quality, food-grade dehydrated and juiced ingredients for human and pet consumption.
Researchers identify control strategies that have potential to increase N.C. corn production: Health effects and trade restrictions resulting from mycotoxin contamination of food and feed are a worldwide problem, reducing yields and threatening human health. The global need for more high-quality grain for food, feed and biofuel production has raised the concern about mycotoxin contamination. Not only does contamination render grains unfit for human and animal food, but it also limits their use as biofuel sources. NCSU scientists have taken multiple approaches to better understand infection of corn with Aspergillus flavus and Fusarium verticillioides and the factors that regulate mycotoxin production. Using genomic and bioinformatics, these scientists have identified candidate genes in maize for resistance to aflatoxin contamination that can be used for either marker-assisted breeding or transgenic approaches to develop resistant lines.
High tunnels show promise as production management tool: Conventional methods in high tunnel vegetable production are labor and chemical intensive due to land preparation and weeding. In addition current land preparation and weeding practices can degrade soil. Conservation agriculture can improve soil quality, reduce land preparation (no-tillage) and also control weeds. Researchers at NCA&T conducted a study comparing high and no high tunnel vegetable production under conventional tilled and conservation agriculture production systems. They found the yield for the high tunnel system was considerably higher compared with conventionally produced vegetables. In addition, Extension conducted a regional high tunnel greenhouse workshop in southeastern N.C. Evaluations completed after the workshops showed that 10 farmers had installed high tunnels since the March 2013 Extension workshops. Three of the 10 high tunnels have begun production and the produce harvested valued approximately $7,500.
Research reveals potential profitability of organic vegetable production in N.C.: The demand for organic fruits and vegetables has grown considerably over the last 20 years, exceeding the overall growth in demand for food. To meet this demand, grocers have had to import organic fruits and vegetables. It is estimated that currently at least 50 percent of organic fruits and vegetables are imported. The profitability of organic produced vegetables was examined by NCA&T researchers using enterprise budgets. Results show that producing organic vegetables would be as profitable and in many cases more profitable than tobacco. There is a need to provide assistance and information on certification, production, marketing and management to farmers interested in entering organic production.
Shiitake mushroom education leads to small grower success: Small, part time and limited resource audiences and other population demographics alike are in search of money making ventures that have low inputs but could yield high dividends. To meet that need, Extension hosted a shiitake mushroom workshop in Franklin County, which included information on how to acquire spawn, tools, inoculation of the proper type, size and quality of logs, along with waxing, tagging and staging of logs, and marketing. One workshop participant reported substantial early flushes of production and sold on one day $500 worth of mushrooms to area chefs.

PLANNED PROGRAM #2

GLOBAL FOOD SECURITY - ANIMALS AND THEIR SYSTEMS, PRODUCTION AND HEALTH

Research on control of inflammatory and parasitic diseases could lead to improved on-farm planning, reduced costs: Gastrointestinal parasites pose a serious threat to the small ruminant industry causing economic losses due to costs associated with ineffective treatment and death of affected animals contributing to 8-10 billion dollars per year loss due to animal health related costs in the US and global threats to food security. NCA&T researchers have been conducting laboratory and farm experiments on the impact of mushroom and microbial probiotics on gene expression for the control of inflammatory and parasitic diseases in sheep, goats and cattle. Findings are being shared with producers, faculty, staff, students in anticipation that the findings will translate into improve planning on farm and design of future scientific studies and thus help to reduce costs through implementation of improved management practices and interventions.
New digital application enables N.C. dairy producers to improve farm profitability: Dairy Records Management Systems (DRMS) received feedback from numerous farmers that reproductive management would be enhanced by using a more extensive view of individual cow data. The existing phone-sized

PocketDairy application brought the data handling cow-side, but farmers requested that DRMS combine the PocketDairy convenience with the comprehensive view provided by their desktop applications. The DRMS development team designed and released Vet Check Maxx, the trade name for an all-in-one view of reproductive and health data combined with complete data entry capabilities. Since the launch of Vet Check Maxx, DRMS has seen a steady increase in daily subscription levels. The average herd size of the mobile user is 360 cows, so the mobile system is in use in the management of 328,000 cows. Vet Check Maxx received the "Top 10 New Products" award at the World Ag Expo in February 2015, likely leading to increased farmer awareness of this system.

Sow body condition caliper reduces feed cost and improves animal well-being: Most of the 5.8 million sows in the U.S. are fed to a subjective body condition target. Yet, visual sow body condition scores typically have low associations with estimated body composition. Developing accurate, cost effective tools to replace visual body condition scoring will allow pig farmers to optimize feeding levels while maximizing sow well-being, subsequent reproductive performance and profitability. To address these issues, an NCSU scientist collaborated with an engineer to create a prototype caliper that quantifies the angularity of a sow's topline. The sow caliper design was completed based on data collected from commercial industry farms. A research project has been initiated with Goldsboro Milling and Prestage Farms to identify the optimal sow body condition in relation to subsequent reproductive performance. Sow calipers have been distributed to farmers in nine countries worldwide and 10 U.S. states. The economic and societal implications of the sow body condition caliper are great. Farms that are overfeeding all or a portion of their sows will realize lower feed costs through the implementation of this new technology. Herds that contain sows that are too thin will realize improvements in sow well-being and subsequent reproductive performance. As a result of using the sow body condition caliper, one N.C. farmer experienced tremendous improvement in gestation feed usage across an 18,000 sow system. Since implementing the sow caliper in 2013 this farmer has reduced his feed cost by nearly $300,000 in both 2013 and 2014. The development and implementation of the sow body condition caliper is significantly improving the profitability of pig farmers.

Researchers investigate impact of swine production environments on animal health: Globally, pork is the most consumed meat resulting in multi-billion dollars of sales worldwide. In the U.S., the vast majority of pigs are reared in confinement production systems. Although modern ventilation systems, sanitation and management program have improved living conditions within production buildings, reduced air quality remains a major contributor to respiratory health due to lung disease and abscesses in animal. To better understand the influence of production environments on animal health, NCA&T researchers investigated the differences in airway lining morphology of pigs reared indoors and outdoors. The possibility of differences in tissue arrangement and cell types within the lining of the trachea (windpipe) of adult (6-7 months; market weight) was comparatively examined in pigs raised exclusively indoors and outdoors. Animals raised indoors have airways that are enhanced with goblet (mucus secreting) cells compared to pigs raised on pasture. While the significance of these observations is not yet known, the findings provide insights for understanding the impact of the production environment on animal health. These findings may have great importance to producers of swine are produced in indoor commercial facilities.

Successful N.C. startup company connects livestock producers to local markets: Firsthand Foods, a company incubated by NCSU's Center for Environmental Farming Systems, connects local livestock producers to local markets by delivering local, pasture-raised beef and pork products to retail and specialty grocers, restaurants and direct to consumers. Firsthand Foods supports a network of 60 livestock producers and is expanding to regions beyond the Triangle area through new partnerships. In 2014, the company realized $1.25 million in sales, with 75% of revenues going directly back to the farmers and processors in its supply chain.

Extension enables small-scale swine producers to increase profits: Several Yancey County small-scale swine producers are transitioning into pastured/semi-pastured pork production. One of the major issues these producers face is determining which forages to plant. Extension taught the producers which forages worked best in research trials and which held up to grazing pressure. Extension also recommended that producers practice rotational grazing techniques in order to soil control erosion. There

are now four small-scale swine producers in Yancey County raising pastured pork, and all are using Extensions recommendations. They have reported better forage stands and less soil erosion and waste runoff. In 2014 these producers were able to market several feeder pigs and a number of slaughter hogs, increasing the profitability of their operations.

Extension aids first North Carolina fish exports to Canada: After years of negotiations between the United States and Canada, the United States Department of Agriculture Animal and Plant Inspection Services (USDA APHIS) developed a registration program that satisfied Canadian importation requirements. Cooperative Extension developed a standard operation procedure (SOP) document for the HSB producers to utilize when registering their farms with USDA APHIS. This SOP document was used in the successful registration of the first fish farm to export to Canada and will serve as a template for other farms in North Carolina and the United States. As a result of this program, the fish producers in North Carolina and the United States will save approximately $2,000 per export transaction going to Canada, amounting to savings of over $100,000 for NC producers alone.

New system for mass swine depopulation could help avert catastrophic disease outbreak: Commercial swine production facilities (CAFOs) house large quantities of animals at a single location. In the event of an animal related disease or a bio-hazardous outbreak, immediate and preemptive action is necessary to contain and eliminate further spread of disease. Systems currently used to euthanatize swine that rely on the handling and restraint of individual animals will likely prove much too slow to stem the spread of disease. A collaboration between NCSU and Murphy-Brown, LLC, has resulted in the development of a portable system for converting bulk liquid CO2 to gas and increasing its temperature to acceptable levels, before administering metered quantities for mass depopulation. This research will enhance the health status of the U.S. meat supply by anticipating and responding to new or emerging biosecurity hazards.

Research and Extension aim to improve pork quality: Producers are in danger of losing markets due to pork quality issues. Researchers at NCA&T are conducting studies involving breeding for better pork quality. Potential breeding stock is being produced to provide options for farmers for marketing pork that will be more acceptable to consumers. Extension efforts have been conducted to expand knowledge on impacts of feeding on pork quality.

PLANNED PROGRAM #3

CLIMATE CHANGE

Unmanned aerial systems (UAS) poised to be next generation of precision agriculture technology in N.C.: Scientists in NCSU's Biological and Agricultural Engineering Department are exploring applications of UAS in precision agriculture and environmental engineering. Evaluation of the aerial platforms and sensor payloads available are underway. UAS offers a wide range of sensor options, many of which are not currently available to agricultural producers on a routine basis. This research could result in the ability to fly over agricultural fields on demand, capture data, and make management decisions on crops with a short turnaround time, potentially revolutionizing precision agriculture practices statewide.

New technology will enable use of valuable animal waste nutrients in the feed production system: NCSU engineers have built a pilot scale ammonia recovery reactor system that can remove 50% of the total ammoniacal nitrogen in a lagoon sample over a period of several days. In cooperation with ARS, these scientists will develop procedures that will facilitate on-farm operation. Development of this technology will help convert the pollution potential of liquid manure application into a valuable fertilizer product that can be transported out of the local watershed, creating business and employment opportunities in rural communities throughout North Carolina.

Researchers investigate practices that increase soil carbon content: Growers use excessive tillage and do not implement agricultural practices that increase soil carbon content. Reduced tillage practices, the application of compost and the growing of summer and winter cover crops are being evaluated by researchers at NCA&T as practices that sequester carbon and increase soil carbon content. Field experiments have been implemented and soil samples collected for determining stability of soil carbon fractionation and analyses. Laboratory analyses are being conducted to determine carbon fractions and fraction stability.

Poultry litter becomes valuable fertilizer, thanks to Cooperative Extension: Poultry production is

North Carolina's largest agriculture sector, accounting for 35.8% of total cash receipts. While litter is a waste byproduct to poultry growers, crop farmers can utilize litter as an excellent fertilizer, thus reducing or replacing their use of commercial fertilizers, usually at a cost savings. Extension delivered waste management plans for new and expanding growers in four counties, resulting in 22,500 tons of litter that could be used to maximize crop production and preserve water quality. Statewide, Extension-recommended waste analysis was used for proper land application on more than 1 million acres.

Storm Water BMP Inspection and Maintenance Training Program helps prevent flooding and control pollution: More than 2,200 people have been certified in Storm water BMP inspection. Respondents reported the following practices under management: 383 bioretention beds retaining $828,000 of Nitrogen and $734,000 of Phosphorus; 1,702 ponds converting $1.75 million of Nitrogen and $1.9 million of Phosphorus; 179 wetlands retaining $1.77 of Nitrogen and $1.2 million of Phosphorus; and 399 vegetated swales converting $985,000 of Nitrogen and $679,000 of Phosphorus.

Research program turns agro-industrial residues and dedicated biomass crops into high value alternative products: NCSU researchers are examining the diversity of renewable resources available and various processing methods that can be applied to generate products and enhance value, such as: semi-solid fermentation technology, enzymatic conversion methods and fermentation for development of effective biomass conversion processes, and hybrid application of thermal and microbial conversion technologies for biofuel production from lignocellulosic biomass. This work has shed light on potential value-added products that can be derived from sweet sorghum, perennial grasses and purple sweet potatoes.

PLANNED PROGRAM #4

SUSTAINABLE ENERGY INCLUDING BIOTECHNOLOGY

Giant Miscanthus treated with swine waste shows promise as biofuel feedstock crop for N.C. farmers: Growth and yield of the Giant Miscanthus (GM) grown with the application of swine waste was studied over a period of two years. Swine waste applied at a uniform rate produced GM yields with good utilization of nitrogen and quality biomass. Timing of harvesting also proved to be important. Overall, the results show that GM is a promising biofuel feedstock crop for the state's farmers.

Innovative Giant Miscanthus bioprocessing technology could be effective way to produce bioethanol: Freshly harvested Giant Miscanthus culm was reduced in size and pressed and separated into green juice and solid cake. The solid cakes were then pretreated with hot water. Results showed that liquid hot water pretreatment and the subsequent simultaneous saccharification and fermentation processing of Miscanthus could be an effective way to produce bioethanol. The results also showed that the green juice could be a highly nutritious source for microalgal culture.

New biorefinery converts wet algae into ethanol, biodiesel and fertilizer: Algal biomass consists of three major components of carbohydrates, proteins and lipids. A simultaneous saccharification and fermentation process was developed to produce ethanol from algal carbohydrates. At the same time, a thermochemical process was used to produce organic fertilizer from the solid microalgae residue in which the N and P have been enriched after the removal of carbohydrates and lipids.

Extension's E-Conservation program helps N.C. citizens conserve energy: Results from Durham County E-Conservation workshops and subsequent home energy assessments and home retrofits revealed a cumulative homeowner savings of $11,550 and an annual collective reduction of 41 metric tons of carbon emissions. Statewide, nearly 500 participants of Extension programs reported that they engaged in best management practices related to energy conservation, resulting in $49,000 in energy cost savings.

Installation of energy saving strategies in tobacco barns cuts fuel costs for N.C. growers: Energy costs for electricity and curing fuel for tobacco represent one of the highest expenses for tobacco growers, second only to labor expense. Cooperative Extension has educated growers on methods to reduce curing costs and to increase fuel efficiency at meetings, in newsletters, and one-on-one visits. Thanks to Extension on-farm testing and a field day in 2014, grower surveys show that 1,350 curing barns now use automatic ventilation controllers in Johnston County. These controllers reduced fuel consumption by an average of 40 gallons of propane per cure. It was estimated that each of these barns cycled at least 8 times during 2014 representing a potential fuel savings of 432,000 gallons of fuel valued at over $583,200.

PLANNED PROGRAM #5

CHILDHOOD OBESITY

Thousands of N.C. adults and youth increase fruit and vegetable consumption, thanks to Cooperative Extension: In North Carolina, about 66% of adults are overweight or obese, and only one in four N.C. children eat recommended amounts of fruits and vegetables. In response to this crisis, Extension's Expanded Food and Nutrition Education Program (EFNEP) helps food insecure families acquire the knowledge, skills and attitudes needed to manage food resources efficiently and to ensure nutritionally sound diets can be consumed on a consistent basis. In addition, EFNEP participants learn how to provide nutritious, safe meals for their families on limited budgets. In addition, Extension's Color Me Healthy program exposes children to healthy foods and increases their willingness to try them. In 2014, 4,742 families and 27,230 school-aged youth participated in a series of EFNEP nutrition education classes. Statewide, nearly 16,000 adults and 21,000 youth increased fruit and vegetable consumption as a result of participating in Extension programs.

Steps to Health program gets North Carolinians moving: Nearly half of the children in North Carolina spend more than two hours watching television every day, instead of engaging in physical activity. Extension's Steps to Health program provided nutrition education with the ultimate goal of promoting positive behavior change related to nutrition and physical activity. Six programs were provided at low-income sites in counties across North Carolina. Steps to Health reached 6,193 participants (5,376 children and 817 adults) and made 46,520 educational contacts within 56 counties across North Carolina. Additionally, 100% of Head Start sites, schools, and congregate nutrition sites reported making a change in their environment and/or policies since a Steps to Health program was delivered at their site. Statewide, nearly 26,000 individuals increased their physical activity as a result of participating in Extension programs.

Eat Smart, Move More, Weigh Less continues to improve health of N.C. citizens: The issue of overweight and obesity continues to be the most pressing public health problem of our time. An estimated 50% of adults attempt to lose weight or not gain weight each year. North Carolina, like many other states, has a plan to prevent overweight, obesity and related chronic diseases. To tackle these issues, Cooperative Extension created the Eat Smart, Move More, Weigh Less (ESMMWL) weight-management curriculum. As of December 2014, a total of 216 ESMMWL online classes with 4,348 participants enrolled have been provided to members of the North Carolina State Health Plan. Statewide, nearly 3,000 individuals reported reduced Body Mass Index (BMI) as a result of participating in Extension programs. The ESMMWL program gained the attention of Blue Cross and Blue Shield of North Carolina (BCBS) as a possible way for them to expand their wellness offerings. The ESMMWL team continues to work with BCBS to offer the program as a covered as a medical expense. Plans are underway for the program to be fully covered by BCBS insurance in 2015.

Extension helps North Carolinians reduce risk for chronic disease: In 2014, North Carolina Cooperative Extension's commitment to the overall health of the state's citizens continued with outstanding results. As part of this effort, NCSU is part of a multi-agency team working with the N.C. Division of Public Health to develop an online portal to be used by primary health care providers. This portal would allow for referral of patients to resources in the community to help them live with chronic diseases including diabetes, heart disease, stroke, and obesity. As a result of statewide Extension programs:

- 750 adults reduced their blood pressure
- 295 adults reduced total cholesterol
- 225 program participants (youth and adults) improved their blood glucose levels
- 5,647 program participants (youth and adults) consumed less sodium in their diets

PLANNED PROGRAM #6

FOOD SAFETY - FOOD PRODUCTION SYSTEMS: DEVELOPMENT, PROCESSING AND QUALITY

ServSafe certifications keep people healthy, food service establishments thriving: The Centers for Disease Control and Prevention estimates that roughly 1 in 6 Americans (or 48 million people) get sick from a foodborne illness each year. Food safety education is believed to be an integral part in preventing foodborne illness outbreaks. In 2014, Cooperative Extension provided ServSafe training and certification to 1,155 food service employees statewide. This program has potentially saved food establishments approximately $3.5 million in costs.

Research discovery leads to increased antioxidant capacity for corn bran: Increasing dietary fiber has important health benefits. Bread is a suitable vehicle for delivering dietary fiber to consumers and fiber-rich cereal brans are often used in producing fiber fortified breads. Corn bran is an excellent dietary fiber source containing 70-86% insoluble dietary fiber. However, the gritty taste and corny flavor limits its use in bread formulations. Various pretreatment methods such as milling, heat treatment and coating have been investigated to reduce these negative effects but have not been effective in removing corn bran's unpleasant flavor or softening to increase palatability. Results from NCA&T research indicated that microfluidization treatment significantly improved corn bran's hydration properties and increased its antioxidant capacities. All response variables examined were affected by both pressure and number of passes, the latter having a more significant effect.

CRISPR technology could have significant impact on a number of different industries worldwide: Technologies being developed at NCSU are being used for the formulation of sustainable foods and the development of new gene therapy tools for human disease. The scientific output of the laboratory has yielded 17 publications in 2014, including papers in Science, Nature, and Molecular Cell, as well as novel patented inventions that have garnered industry interest and national media coverage (scientific and popular press, including Forbes and the New York Times). A number of global industry presentations, including those to Fortune 500 companies (DuPont, GSK, Syngenta, GE) and start-up companies (Caribou Biosciences, AgBiome, Intellia Therapeutics, Precision Biosciences), have resulted in several companies seeking licenses from NCSU regarding these technologies.

University/business partnership has potential to revive N.C. blue crab industry: Mechanical extraction of raw crabmeat results in 300 percent higher yield, with substantially less labor input, than the current industry process of cooking, cooling and hand-picking crabmeat. Recently a patented method for restructuring raw crabmeat was issued to Shure Foods Inc., a fledgling North Carolina-based company. NCSU researchers partnered with Shure Foods to further develop and commercialize the technology and help the company transition from R&D to a sustainable business. The team is in mid-phase of a number of experiments designed to ensure consistent performance in restructuring, stability in storage, and maintaining consistent, desired quality attributes in transglutaminase treated raw crabmeat products. The expected outcomes should deliver technical solutions for insuring a robust, consistent process for commercial production of high quality restructured crabmeat products, leading to full commercialization, and thus revival of the blue crab industry in eastern North Carolina and the mid-Atlantic region of the United States.

Food safety HACCP workshops help stem foodborne illness outbreaks: In the U.S., approximately 48 million people fall victim annually to foodborne illness. Two major contributing factors to foodborne illness are poor hygiene practices and contaminated food and beverages. However, the risk of foodborne illness is unlikely when food is handled safely from the time of receipt until service. To ensure proper training of food service employees, Extension provides HACCP (Hazardous Analysis Critical Control Point) trainings that cover everything from proper hand-washing to preparation and service. Statewide, 132 program participants were certified in food safety HACCP programs.

PLANNED PROGRAM #7

HUMAN AND COMMUNITY DEVELOPMENT - YOUTH DEVELOPMENT AND FAMILIES

Cooperative Extension helps families create budgets, plan for the future: Family and Consumer Science Agents collaborated with county and state partners to conduct workshops, conferences and other educational events addressing the importance of basic money management skills. As a result of efforts, 2,565 individuals and families implemented basic financial management strategies and 7,288 people accessed programs and implemented strategies to support their family economic well-being. Additionally, as a result of Extension programs in retirement planning, 828 people accessed financial products and programs aimed at accumulating wealth.

Research-based mentoring program and curriculum aim to help teen mothers: Some teen mothers struggle to become skilled parents due to the responsibility of caring for a child during their own adolescence. Their parents and family members, professionals, and mentors can serve as valuable role models and educators to support the growth of teen mothers' parenting skills. To address this, a team of NCA&T researchers set out to improve teen mothers' abilities to provide positive parenting through

mentoring and education. Faculty researchers worked with YWCA Greensboro program directors to create a mentoring program and curriculum in which undergraduate students from the Department of Family and Consumer Sciences serve as mentors and deliver program content in biweekly sessions. Parenting content developed in this program includes curriculum modules focused on proactive parenting, communicating with young children, conflict resolution, and father involvement. Teen parents are learning how to predict when their children might misbehave so they may be able to avoid discipline and punishment when possible. The teen mothers and their mentors talk about their parenting actions to determine if they had been able to implement proactive parenting strategies and discuss promoting positive behavior through reinforcement.

Extension helps prepare citizens to become homeowners: According to the Center for Home ownership and the Housing Authority of Winston-Salem, it can take up to five years before families are ready and eligible to purchase a home. Many families lack the knowledge of using money wisely and they live from check to check. Financial education and budgeting is a must for families to increase knowledge, adopt and practice skills in budgeting. Cooperative Extension and Winston-Salem Federal Credit collaborated with the Housing Authority of Winston-Salem to provide sessions on everything from budgeting to how to read and understand a credit report. As a result of these programs, participants reported improved knowledge by 80 - 100% in areas including budgeting, debt reduction and prioritizing needs vs. wants.

E-Conservation program teaches citizens how to curb energy consumption: Family and Consumer Science agents collaborated with state, county and local partners to conduct residential energy education programs through the E-Conservation Program. Agents use workshops, educational products and conferences to provide education, as well as provide consumer energy kits and energy assessments (using local auditors) to help reduce energy consumption in the home. As a result of efforts, 705 participants increased their knowledge about best management practices related to energy use and energy efficiency. Nearly 500 individuals used best management practices to reduce energy use and increase energy efficiency in their homes, business, agricultural industries or government.

Extension helps build strong families through education on positive parenting practices: Family and Consumer Sciences agents direct educational workshops, conferences, camping experiences, and other outreach efforts focused on developing parenting skills. These efforts address the importance of family time and identify real life concerns and issues facing parents. As a result of educational programs 8,712 youth and adults used effective life skills and 2,639 adults increased their use of identified community resources.

Thousands of youth gain critical life skills through 4-H: North Carolina offers its youth and families a number of unique opportunities to discover the world through 4-H camp and educational programs, to learn 21st century skills, to serve their communities, to learn employment skills and to learn how to be citizen leaders. In 2014, more than 232,000 youth participated in 4-H day and residential camping, 4-H club activities, and school enrichment programs. The focus of the various activities included healthy eating, preparing youth for an employable future, building community volunteerism, developing life skills, and achieving academic and educational success. Additionally, as a result of 4-H school enrichment efforts, 101,319 youth increased their knowledge in STEM, 42,474 girls participated in 4-H STEM programs, 24,914 youth gained career/employability skills, 5,738 youth increased their knowledge of entrepreneurship, 8,028 youth participated in 4-H drop-out prevention programs, and 3,333 teachers were trained in 4-H STEM curriculum.

North Carolina 4-H helps combat hunger: One in four North Carolina children faces hunger. According to the 2014 Kids Count Data Book, North Carolina ranks 34th in the nation in child well-being. North Carolina 4-H continues to promote health and wellness as one of its major focus areas in efforts to raise awareness of hunger. In 2014, 27,230 youth participated in 4-H EFNEP (Expanded Food & Nutrition Education Program) and 1005 reported positive behavior changes in one of more of the following areas: daily physical activity, healthy food choices, and food safety in preparation and storage. Statewide, 94,677 4-H youth were active in special interest activities. Also in 2014, 4-H'ers participated in more than 76,000 foods and nutrition activities/programs.

Research aims to improve home accessibility for older citizens: As homeowners age, their quality of

life at home is a concern if the homes are not built to accommodate their physical challenges. Little research exists related to home accessibility for older limited resource homeowners for post-retirement. NCA&T researchers conducted personal interviews with 30 limited resource homeowners in a central NC city, aged 55 and over, who completed home modifications about their home improvements. Content analysis was used for qualitative data analysis. Information regarding the types of home modifications along with information concerning housing costs and living conditions and the need for more improvements was obtained. The two most home modifications relating to improving home accessibility were: exterior ramps and bathroom grab bars. 70% of homeowners reported needing additional improvements for home accessibility.

PLANNED PROGRAM #8

HUMAN HEALTH, NUTRITION AND WELL-BEING

Plants and related natural products offer a 'final frontier' for new drug and health product discoveries: In 2014, researchers at NCSU's Plants for Human Health Institute engineered development of protein-phytoactive stable functional ingredients for use in fortified foods that require long shelf life and portability (e.g. sports, NASA, Army), and demonstrated that consumption of the ingredients improved physical performance, weight management, and endurance. In addition, routine intake improved immune response in athletes compromised after sustained physical exertion. Preliminary outcomes have led to research partnerships with the U.S. Army and discussions with food companies with interest in adapting technology to consumer products, specifically for the performance athletics market, and for allergy concerns.

Research has potential to lead to new therapeutic methods for cancer treatment: Apoptosis, or controlled cell death, is dysfunctional in cancer cells, which leads to an accumulation of unwanted cells that are unable to die. Current chemotherapeutic agents used to treat various forms of cancer induce cell death by re-establishing apoptosis. A major disadvantage of the current therapeutic strategy is that tumorigenic cells build resistance to these drugs because the therapies target proteins that have early entry in the apoptotic program. Consequently, combined approaches are generally used to increase effectiveness. Even with combination therapy, an astounding one in four deaths in the U.S. are due to cancer, suggesting that alternative therapeutic strategies are required to decrease the mortality rate of this disease. Procaspase-3 is the terminal protein in the apoptotic cascade that, once activated, commits the cell to undergo apoptosis. Currently there is no therapeutic strategy to directly activate procaspase-3 even though there is a large pool of inactive procaspase-3 in many cancer cells. NCSU scientists are studying the activation of caspases and other closely related proteins. By understanding how caspase-3 is formed and activated, it may be possible to design small molecules that activate it in cancer cells. Such compounds would represent new therapeutic methods for the treatment of cancer.

Grape pomace investigated for "superfood" potential: Grape pomace (GP), a residue of grapes from wine industry, has great potential to serve as an antioxidant and dietary-fiber-rich ingredient to improve the nutritional value of food products. However, the particle size of GP may influence its health benefits and applications. Pomaces of four cultivars of grapes grown in North Carolina were collected, dried and processed into powders with four different average particles sizes. The effects of particle size on functional properties were evaluated. This NCA&T research showed that reducing particle size of GP mechanically can improve the accessibility of polyphenol, which may increase the bioavailability of GP polyphenols when GP-containing food products are consumed.

Research addresses emergence of Carbapenem-resistant Enterobacteriaceae (CRE) as a rising public concern: CRE is often associated with multidrug resistance, which results in limited therapeutic options. Most CRE infections are associated with people in hospitals and health care facilities. Researchers at NCA&T collected 50 samples presumptive positive for Carbapebenemase and Metallo-&beta-lactamase isolates and streaked them onto chromagenic agar to detect the presence of Klebsiella pneumonia and confirmed Klebsiella pneumonia using polymerase chain reaction (PCR). The PCR confirmed K. pneumonia samples were then tested for the presence of NDM using PCR. The results show that 46% of the tested samples were presumptive K. pneumonia. Eight-two percent of the presumptive positive samples were PCR-confirmed K. pneumonia. Seventy-Eight percent of the confirm K. pneumonia was PCR confirmed for the presence of NDM.

Research on Campylobacter could lead to reduced risk of infection: Poultry is the number one food animal product associated with cases of Campylobacteriosis in humans. Campylobacter infections in humans tend to be self-limiting but the medical costs and associated costs due to missed work, etc., are staggering. This issue is very important to the industry as carcasses contaminated with Campylobacter are a zoonotic threat to consumers. NCSU scientists have been collecting samples on farm and attempting to identify patterns for infection and antibiotic resistance. Their goal is to identify risk factors for introduction of Campylobacter onto a farm, then develop mitigating practices to reduce the risk. Researchers have gathered much information and have raised awareness of this as a potential food-borne pathogen for the growers/workers as well as the consumers.

Cockroach research could translate into improved control methods: NCA&T researchers are investigating the German cockroach, Blattella germanica (L.), which is capable of transmitting disease-causing agents such as Staphylococcus spp., Streptococcus spp., hepatitis virus, and coliform bacteria, and the lack of effective pest management practiced in homes and child care centers. The research team conducted on-site surveys on German cockroach control with residents in three North Carolina counties. Resistance to bait formulated products by the German cockroach was evaluated and the presence of pathogenic microorganisms and allergens associated with the presence of German cockroach was determined. The researchers found that German cockroaches from different residential homes and day care centers had different tolerances to commonly used insecticidal bait products, indicating that each strain had a unique treatment history. In general, dinotefuran was the most toxic insecticide to all strains and avermectin was least toxic. The presence of pathogenic bacteria and cockroach allergens (Bla g1) in residential homes and daycare centers also was identified.

NOTE: For the NC State University estimated FTEs/SYs entered into the table below, we are calculating our Extension FTEs differently than in the past. Prior to the FY2013 report, this parameter was defined as campus based extension faculty with some extension appointment. Going forward, we will be calculating this parameter to represent combined FTEs of extension campus and field faculty, funding for which comes from NC State University. Thus, if you compare to FY2014 report numbers given for NC State University 1862 extension to years prior to FY2013, there is about a 30% increase in FTE numbers for extension.

NOTE: No federal Smith-Lever nor Hatch funds are used to support our tobacco program; other sources of funds support the program. Because tobacco research and extension represent a significant aspect of our programs and of the economy of North Carolina, we have included in this report outcomes and impacts of our tobacco research and extension efforts.

NOTE: The "All Other Sources" of funding indicated in our program "Human Health, Nutrition and Well-being" for research are considerably greater than we've reported in the past. A substantial appropriation from state government is directed to support that program and is so indicated in this year's accomplishment report.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	400.0	78.0	425.0	46.0
Actual	493.0	72.0	407.0	42.9

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- External University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

For NCARS, a thorough scientific and merit review of each proposed new or revised research project is done at the departmental level prior to submission to the NCARS office. This departmental review consists of two parts: an informal review (PI's responsibility) and a formal review (Department Head's responsibility). Cooperative Extension's work is closely coordinated with NCARS efforts. In fact, numerous Extension faculty within the College of Agriculture and Life Sciences at North Carolina State University have joint appointments with NCARS. Extension on-campus faculty collaborate with almost 400 state and county supported Extension agents, who plan and deliver educational programs across the state. This effort is further strengthened by the Extension programmatic efforts of NCA&T agents and faculty, who collaborate with NCA&T researchers. In addition to this alliance with research faculty at both institutions, Extension benefits from the input of a well-established statewide system of lay advisers representing the state's diverse population. Also, each county routinely conducts an environmental scan to determine emerging needs and appropriate education responses. These scans give residents, advisers, commodity group representatives, volunteers and other clients the opportunity to ensure that local programs meet local needs and priorities. Stakeholder input undergirds all of Extension's efforts.
The research director in SAES determines the need, priority, and scientific feasibility of proposed Evans-Allen projects and the development and implementation procedure for project documentation, merit review, and selection. The procedure assures that research proposals are scientifically sound, relevant to society's food and agricultural needs, and not duplicative of efforts undertaken elsewhere. Prior to proposal development, alignment of the research topic with the needs of the state and the direction of the eight program initiatives of SAES is determined. Upon agreement by the department chair, the associate dean for research, the research director, and the principal investigator, a proposal on the topic for submission through the Evans-Allen program is prepared. The merit review process includes a review by five peer reviewers from both within and outside the University who are knowledgeable of or familiar with the area of research. The principal investigator incorporates suggestions made by the reviewers and must give reasons for any substantive suggestions not included or addressed. The proposal is then reviewed by the associate dean for research, who determines if additional review and substantive revision is necessary. Upon acceptance by the associate dean for research and research director, the proposal is submitted for budgetary review by the Office of Agricultural Research and then transmitted to NIFA/USDA for approval.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public

- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of selected individuals from the general public

Brief explanation.

Extension has an ongoing system of securing stakeholder input in program planning, implementation, and quality assessment has and continues to be a primary commitment for North Carolina Cooperative Extension. An Advisory Leadership System is functional in each of North Carolina's 100 counties. The system includes an Advisory Council and many specialized committees. The Advisory Council represents geographic, cultural and economic diversity within communities of the county. Its function is to provide overall programmatic review and conduct environmental scans and needs assessment for program direction. Council members represent the diversity of the respective county population to assure the inclusion of under-served populations. While the advisory council meets quarterly, the specialized committees meet at least annually to discuss accomplishments and needs still to be addressed. This system is monitored administratively to assure that stakeholders provide program input and actions. At the state level, a Statewide Advisory Council provides programmatic inputs, review, and guidance for the overall program functions of the North Carolina Cooperative Extension Service at N.C. State University. This group meets quarterly as well as for other special meetings to provide organizational review and input. This Council is made up of influential individuals who represent a broad scope of the diverse population in North Carolina and who have distinguished themselves as respected, responsible, and knowledgeable leaders who can provide local perspectives to a statewide organization. In addition to being an integral part of the overall State Advisory Council, the Extension Program at NCA&T State University is also guided by a cadre of citizens who make up the Strategic Planning Council.
The Strategic Planning Council includes community leaders, agribusiness persons, representatives from non-governmental organizations, representatives from the State Advisory Council, representatives from county-based specialized committees and elected officials. The Strategic Planning Council meets three times a year as a group. Networking and collaboration between the State Advisory Council and the Strategic Planning Council is facilitated by two members who serve on both Councils. Members of each Council periodically meet jointly. With these organized groups emphasizing and providing significant stakeholder input into program direction, a planned and proactive process is operational that assures that programs are reviewed and overall needs assessed on a continuous basis, but no less than once every two years, with greater frequency encouraged. However, the respective advisory groups provide more frequent stakeholder input, which means a continuous process of program review and adjustment is available to address changes in local needs. An environmental scanning process is implemented in each of the state's 100 counties. This scanning process helps to assure that a large amount of input is gained from the citizens whom the research and extension efforts are intended to serve.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

As indicated in the Plan of Work, a deliberate initiative is continuously underway by research and extension programs to meet, listen to, involve, and interact with any and all stakeholders. These efforts are carried out in a highly proactive manner. In addition, commodity association members and representatives, county commissioners, state legislators and many other leaders and policy makers both at the local and statewide levels have varying degrees of influence and interaction regarding program direction, issues identification, budgets, staffing and developing plans of action. This is an on-going function that is ingrained in the program planning and implementation for both research and extension in North Carolina. It is our intent to involve and serve the citizens of the state in the most effective ways possible to enhance the quality of North Carolinian's lives and economic well-being.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

Cooperative Extension uses mailed surveys, electronic/web surveys, telephone surveys, one-on-one interviews, focus groups, and community forums to collect stakeholder inputs for the needs assessment and program prioritization process. NCARS is committed to seeking, receiving and using input from all stakeholder groups, including under-represented groups and the general public. A significant portion of the input from individuals throughout the state comes from interactions of research scientists with county-based extension personnel and directly with producers, industry and other agribusiness representatives. Many research faculty also have extension appointments. These faculty are the primary day-to-day communication link between agribusiness, county extension centers and NCARS. Because research and extension activities are directed toward the development and implementation phase of new knowledge and technology, faculty members are constantly relating industry needs and suggestions to other researchers, whose emphasis is more in the discovery phase. In addition, faculty interact with county extension personnel in such a way that input from individual consumers is also effectively communicated to NCARS administration and faculty.
Strategic planning efforts in Cooperative Extension and for the entire college have benefitted from concentrated efforts by college leadership to engage stakeholders through listening sessions, focus groups, and state-wide conferences and workshops have all benefitted from engagement of relevant stakeholder groups.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs

- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

The environmental scanning process entails obtaining both secondary and primary data on key issues of concern, needs and assets in the community. Secondary data are used to assess the analyzed needs (data and statistics) as well as needs identified/prescribed by experts. Primary data were collected by holding meetings, focus groups and/or interviews with key stakeholders such as extension advisory leaders and county government partners. These combined data and input were used to prioritize and target issues, needs and assets that serve to focus, guide and direct extension programming. For research, stakeholder input is especially used in determining research directions as well as for gaining program support and advocacy for research initiatives. For example, the commodity association boards provide information on high-priority research areas to be used in requests for proposals, and boards then decide which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities. Also, leaders in the North Carolina Agricultural Foundation, N.C. Farm Bureau Federation, N.C. State Grange, N.C. Department of Agriculture and Consumer Services, N.C. Agribusiness Council and numerous other organizations not only provide insight on research needs and priorities but also assist in program reviews as well as advocate for research by promoting the importance of agricultural and life science research.
Stakeholder input during strategic planning processes has provided useful direction to enable Cooperative Extension and the college focus on those programs that are consistent with the college's mission and vision. In addition, relationships developed during these processes are providing stakeholder support for major legislative initiatives, financial development opportunities, student recruiting and positive stakeholder involvement in the future.

Brief Explanation of what you learned from your Stakeholders

Many issues identified as key concerns by North Carolina citizens are addressed by Cooperative Extension programs. Agricultural preservation, sustainability and development, and nutrition and health were identified as key issues. Increasing economic opportunity, business development, and developing community leaders were other key issues. Environmental stewardship and natural resource management were identified across the state as well. A continued emphasis and concern about building strong families and developing responsible youth as well as educational opportunities for the state's citizens were all labeled key issues facing North Carolina. NCARS maintains close ties with 90 state agricultural industry associations, of which 24 provide funding to various research projects annually, usually on a competitive basis. In these cases, the association boards give NCARS information on high-priority research areas to be used in requests for proposals, and boards decide which proposals to fund. This is the most targeted type of stakeholder input, having a direct effect on research activities. Many of the departments within the College of Agriculture and Life Sciences have formal advisory groups with stakeholder members that meet on a regular basis to provide input and guidance into departmental research programs. In addition, there are formal centers within the college with industry advisory boards that meet at least twice per year, adding additional stakeholders providing input and direction for research programs. NCARS receives support annually from college-based foundations, including the Agricultural Foundation, Tobacco Foundation and Dairy Foundation. These foundations fund research projects and graduate students on a competitive basis across a wide range of areas. NCARS administration meets with the research and extension committees each fall to discuss priority areas for research in all aspects of agricultural production and agribusiness. In late winter, these committees meet again to select and approve research projects for funding, with provides another opportunity for input on research

priorities. As greater emphasis is placed on integrated extension and research efforts, administrators and program personnel hold both research and extension appointments and duties. These personnel continuously interface on decisions for program prioritization, budgeting and staffing. These efforts help ensure a greater exchange of information from the state's citizens and that all audiences are identified and served to the extent possible given research and extension resources.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
11821764	3661204	8077663	4220752

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	8718268	1728887	7144377	3953893
Actual Matching	8718268	863668	7144377	1028948
Actual All Other	31777794	691737	64698130	3766404
Total Actual Expended	49214330	3284292	78986884	8749245

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	825649

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security - Plant Production Systems and Health

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	5%	10%	8%	20%
202	Plant Genetic Resources	10%	10%	10%	10%
204	Plant Product Quality and Utility (Preharvest)	5%	5%	5%	5%
205	Plant Management Systems	18%	20%	12%	25%
206	Basic Plant Biology	10%	10%	10%	20%
211	Insects, Mites, and Other Arthropods Affecting Plants	10%	10%	10%	10%
212	Diseases and Nematodes Affecting Plants	10%	15%	10%	0%
213	Weeds Affecting Plants	12%	15%	10%	0%
216	Integrated Pest Management Systems	5%	5%	6%	10%
404	Instrumentation and Control Systems	1%	0%	3%	0%
511	New and Improved Non-Food Products and Processes	1%	0%	2%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	1%	0%	2%	0%
601	Economics of Agricultural Production and Farm Management	3%	0%	4%	0%
602	Business Management, Finance, and Taxation	3%	0%	4%	0%
604	Marketing and Distribution Practices	6%	0%	4%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	102.0	16.0	160.0	7.0
Actual Paid	125.0	18.0	156.0	8.8

Actual Volunteer	100.0	0.0	56.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
2216568	371855	2747727	922900
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2216568	355249	2747727	162892
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
8090600	133427	19685750	1731324

V(D). Planned Program (Activity)

1. Brief description of the Activity

•Conduct discovery research on plants and plant systems using tools genomics, metabolomics, and proteomics

- Develop improved crop varieties using traditional and genomic approaches
- Introduce/discover new plants for food use and the green industry
- Develop systems for production of plants for biofuels
- Seek new uses for plants and plant byproducts
- Develop production systems for organic farmers
- Develop diagnostic techniques for indigenous and introduced pathogens
- Partner with industry
- Develop sustainable production systems for both large scale and limited resource farmers
- Enhance IPM programs through new techniques and strategies
- Set up applied research/demonstration plots
- Write papers for scientific community
- Prepare publications for grower and homeowner audiences
- Develop web sites to deliver information to grower and homeowner audiences
- Conduct workshops, meetings, and other focused educational programs for farmers, commodity groups, and industry.

2. Brief description of the target audience

- The scientific community
- Regulatory agencies
- Agricultural chemical companies
- Agribusiness
- Commercial and limited resource farmers
- New and Part-time farmers
- Homeowners
- Consultants
- News media
- General public

- Non-governmental organizations
- Other public agency staff

3. How was eXtension used?

Communities of Practice are available in eXtension for an array of field, horticultural and ornamental crops and related areas that provide a resource for producers, handlers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	455872	1501185	16810	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2014
Actual:	18

Patents listed

Method and Compositions for Improvement in Seed Yield. 5051.834.WO

Pinnacle Southern Highbush Blueberry Plant. 14/120,395

Tobacco Inbred Plants NC174 SRC, CMS NC174 SRC, NC821-11 SRC, and Hybrid NC 5 SRC. 61/978,253

Tobacco Inbred Plants NC775 Bmr/Bmr SRC, CMS NC775 Bmr/Bmr SRC, and NC 645 Bmr/Bmr SRC and Hybrid NC 8 SRC. 61/978,340

Tobacco Inbred Plants NC1209-23 SRC, CMS NC1209-23 SRC, and DH98-325-5 SRC and Hybrid NC 6 SRC. 61/978,326

Tobacco Inbred Plants NC1426-11 SRC, CMS NC1426-11 SRC, NC1426-17 SRC, and Hybrid NC 4 SRC. 61/978,246

Tobacco Inbred Plants NC1209-23 SRC, CMS NC1209-23 SRC, and DH19 SRC and Hybrid NC 3 SRC. 61/978,244

Tobacco Inbred Plants Burley 21 SRC and CMS Burley 21 SRC. 61/978,312

Tobacco Inbred Plants NC 2002 SRC and CMS NC 2002 SRC. 61/978,305

Tobacco Inbred Plants NC 2000 SRC and CMS NC 2000 SRC. 61/978,247

Tobacco Inbred Plants Banket A1 SRC and CMS Banket A1 SRC. 61/978,253

Interspecific Hybrid Flowering Pear 'NCPX1'. 13/999,897

Miscanthus sinensis Grass Named 'NCMS1'. 13/999,797

Transcription Factors that Regulate Nicotine Biosynthesis in Tobacco. 5051.826.AR

Tobacco Inbred Plants NCBEX1D, NCBEX1MS and NC EX90. 5051.809.BR

Albizia Julibrissin Tree Name 'NCAJ1'. 5051.842

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90. 5051.809.RU

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90. 5051.809.IN

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	219	725	944

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies conducted to identify new germplasm and develop new and improved varieties of crops and ornamentals

Year	Actual
2014	50

Output #2

Output Measure

- Clients to receive plant information via printed publications, fax, e-mails, phone and other contacts via known non-face to face delivery means.

Year	Actual
2014	1501185

Output #3

Output Measure

- Educate growers and other clientele through highly focused non-degree credit workshops and other formalized group educational sessions.

Year	Actual
2014	3107

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Income as a Result of Production of New or Alternative Crops/Enterprises
2	Increased profit through the adoption of improved nutrient management practices
3	Number of releases of germplasm and varieties with improved yield potential and other qualities
4	New techniques and products developed and released that can be commercialized
5	Increased profit through the adoption of new production practices
6	More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.
7	Increased acreage of organic crops and specialty crops.
8	Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them
9	Increased profit through the adoption of new production practices *and marketing locally*
10	New organic, farmers and agritourism markets established by individual entrepreneurs
11	Growers Adopting Improved Business Management Practices

Outcome #1

1. Outcome Measures

Increased Income as a Result of Production of New or Alternative Crops/Enterprises

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2013, prices for wild harvested ginseng reached record high of $1,200 per dried pound. Watauga County has ideal growing conditions for ginseng, and landowners are interested in cultivating ginseng in ?wild-simulated? conditions to produce income from their forestlands. Wild populations of ginseng have become scarcer due to poaching and overharvesting. Cultivating ginseng in a wild-simulated or woods-grown environment can decrease pressure on wild populations and allow forest landowners to produce cultivated ginseng and seed for income from their forestlands.

What has been done
Cooperative Extension held a ginseng planting workshop and made individual visits to eight farms to demonstration the proper soil fertility amendments and establishment and maintenance practices for ginseng production.

Results
Eight growers successfully planted 1,000 lbs of ginseng seed during the fall of 2014. Harvest of seed, rootlets and berries should conservatively yield more than $1 million to these producers in four to eight years. In an example of alternative production system, NCA&T researchers examined high-tunnel vegetable production systems and discovered that the yields for high-tunnel systems employing conservation agriculture techniques were considerably higher than those of conventionally produced vegetables. In addition to increasing yields, conservation agriculture also

can improve soil quality, reduce land preparation, and control weeds.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Increased profit through the adoption of improved nutrient management practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nitrogen rates cannot be determined through soil test, and therefore North Carolina uses a concept known as the Realistic Yield Expectations (RYE). A database was developed over 15 years ago by an interagency group of soil scientists and agronomists. The database provides yield goals, nitrogen (N) factors, and the RYE N rate. The information includes, by county, yields for all major crops by soil series. The Interagency Nutrient Management Committee (NCSU Soils, NCDA&CS, USDA-NRCS, and NCDENR) determined that particularly for corn, which has new genetics, that the RYE may not be appropriate. Thus a group of soil scientists used N response trials on corn for the last 15 years to determine optimum N rates and determine the appropriateness of corn RYEs.

What has been done

Experiments were randomized complete block designs with generally 4 replications. Often 4 to 6 N rates were tested but other factors such as spacing, fertilizer types, timing and placement were also considered. Irrigated experiments were deleted as the RYE database assumes rain fed conditions. Thus a total of 46 experiments were included in the analysis. The experiments represent 16 Soil Management Groups (SMGs): 10 in the Coastal Plain and three each in the Piedmont and Mountain.

Results

After analyzing the data, which was presented to the INMC, these RYE recommendations for corn were accepted at their meeting in May 2014 and the on-line RYE database was changed. Corn yields for each soil mapping unit, except the mountain floodplain soils, were increased by 20% and the N factor was decreased accordingly such that the N fertilizer rate remained the same. Because of this change in corn, the N factor for corn is no longer tied to the SMG but rather depends on the soil mapping unit. The revised RYEs have been updated on the NC Nutrient Management website. All farmers in North Carolina who produce corn should be determining their N rates based on this information. For many farmers, they could reduce fertilizer N, maintain yields, save money, and protect the environment by using the N RYE yields and N RYE rate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Number of releases of germplasm and varieties with improved yield potential and other qualities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sweet potatoes are the most important vegetable crop produced in North Carolina, and the 1.58 billion pounds produced here account for roughly 50 percent of the nation?s supply in 2014. To remain competitive, the state?s growers need new varieties. All new varieties need to be high-yielding and resistant to diseases and insects for sustainable, environmentally sound production.

What has been done
NCSU has developed what is considered by some to be the world?s premiere sweet potato breeding program, enhanced by a grower-participatory breeding project that is a long-term partnership between researchers, Extension agents and sweet potato farmers.

Results
In 2005, the program released ?Covington,? a new table-stock variety that has changed the landscape of U.S. sweet potato production significantly. Based on USDA NASS crop value estimates, the farm-gate value for ?Covington? in 2014 was about $206 million. ?Covington? accounts for 90 percent of the North Carolina sweet potato crop, and it is also being grown in other states, accounting for roughly 40 percent of the U.S. sweet potato crop. In addition, the ?Sweet Caroline? series of ornamental sweet potatoes has now generated a total of $1.7 million in royalties and has become the preeminent sweet potato series in the ornamental industry, generating an estimated $80 million in receipts at the retail level since release. Such success has also seeded future progress by attracting significant grant funding from two global foundations: the Bill & Melinda Gates Foundation based in Seattle, Washington, and The Global Crop Diversity Trust based in Bonn, Germany. The Genomic Tools for Sweet Potato Improvement project is focused on developing next generation genomic, genetic and bioinformatics tools to facilitate sweet potato improvement in sub-Saharan Africa, while the Global Crop Diversity Trust project is exploring the feasibility of using wild relatives for sweet potato improvement.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #4

1. Outcome Measures

New techniques and products developed and released that can be commercialized

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Eastern North Carolina has traditionally been a leader in the tobacco industry, but that industry has been in decline, creating the need for new enterprises and jobs. The highly nutritious sweet potato, which grows well in the region, has been seen as a potential key to economic development.

What has been done
In collaboration with Universal Corporation consultants, engineers and researchers at NCSU developed an innovative new procedure to process sweet potatoes that are sound and wholesome but currently have been unused due to surface defects and less desirable shapes and sizes that don?t affect their nutritional assets.

Results
In August 2014, Carolina Innovative Food Ingredients Inc. broke ground for a $20 million sweet potato processing facility near Nashville, N.C., that will use the NCSU research to process sweet potatoes into value-added, high-quality, food-grade dehydrated and juiced ingredients for human and pet consumption. The company will target the $60 billion health and wellness beverage market, the $143 billion healthy foods market, and the global pet food business. Production is expected to begin during the first quarter of 2015, and the plant is expected to create more than 60 jobs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #5

1. Outcome Measures

Increased profit through the adoption of new production practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	60000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Because prices for commodities, including peanuts, are low relative to the cost of production, high yields are necessary for growers to maintain viable farm operations. Fungicides that control leaf spots and other peanut diseases represent one of the major inputs in peanut production. These fungicides are critical for producing high yields, but overuse increases the cost of production and increases the likelihood that fungicide resistant strains of pathogens will develop, rendering disease control ineffective. Excess fungicide use also can lead to outbreaks of non-target pests such as spider mites and may endanger sensitive habitats and species.

What has been done
Ongoing research North Carolina State University research has documented that the number of fungicide sprays applied to peanut could be reduced without sacrificing yield, particularly on partially resistant cultivars. Extension programs encouraged growers to reduce the number of fungicide sprays applied by delaying the start of calendar fungicide spray programs, planting cultivars with partial resistance to leaf spots and other diseases, and by using daily weather-based disease advisories.

Results
Growers in North Carolina average about 4 fungicide applications per year for leaf spot control, down from an average of 5-6 sprays per year 10 years ago. At an average cost of $17 per spray, this represents a savings of $17 to $34 per acre out of a projected fungicide budget of $85 per acre for five sprays or $102 for six sprays. With peanuts harvested on 93,000 acres, this represents a statewide savings to growers of $1.58 million to $3.16 million in 2014. Reducing the number of fungicide applications on peanuts also reduces the risk of problems associated with excess use.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	189242

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Peanut pod maturity is very hard for farmers to determine because peanuts are underground and do not show signs of maturity above ground. Pod maturity determines the taste, milling quality, grade and shelf life, which in turn greatly affect the profit of the peanut farmer. Research has shown that farmers can lose up to 19 pounds of yield per day if peanuts are dug too soon, and harvesting too late increases losses as mature pods shed from the plant.

What has been done
North Carolina Cooperative Extension centers held peanut maturity clinics designed to help growers determine optimum digging time. Agents in nine counties reported more than 200 participants with more than 23,000 acres of peanuts.

Results

Agents in the reporting counties estimated that by following Extension recommendations, growers saw increased sales of more than $1.3 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #7

1. Outcome Measures

Increased acreage of organic crops and specialty crops.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolinians consume far more organic vegetables than North Carolina growers produce. With a supply gap totaling over $7 million, an opportunity exists for N.C. growers to enter this expanding market, but significant hurdles stand between an interested grower and a successful certified-organic operation. Beyond the complexities of certification, organic production requires a complete revision of production strategies.

What has been done
To assist 12 area growers in navigating the path toward certification, Cooperative Extension designed and offered a class series on certified organic vegetable production for new and transitioning growers. Topics covered included organic soils, insect, disease, and weed management with an emphasis on translating practical farm techniques into required farm plans

and field records.

Results

In 2014, two new farm operations entered certified-organic production and three others began growing organically with the goal of becoming certified. New sales for the year are projected to increase by at least $7,000 for new growers and more than twice that for past class participants who continue to expand organic production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	18

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Health effects and trade restrictions resulting from mycotoxin contamination of food and feed are a worldwide problem, reducing yields and threatening human health. The global need for more high-quality grain for food, feed and biofuel production has raised the concern about mycotoxin contamination. Not only does contamination render grains unfit for human and animal food, but it also limits their use as biofuel sources. Resistant genotypes are not available, and cultural

practices are not reliable. More effective control strategies are needed to sustain and increase corn production in North Carolina and the United States.

What has been done

NCSU scientists have taken multiple approaches to better understand infection of corn with Aspergillus flavus and Fusarium verticillioides and the factors that regulate mycotoxin production. First, they have monitored gene expression in these fungi and in developing corn seeds, and through these studies have identified genes that are specifically induced during this interaction. Second, they have begun a phenotyping project on near isogenic lines of corn that will allow them to develop new breeding strategies for the control of mycotoxin contamination. Third, they have continued breeding efforts to move resistance to fumonisin contamination into desirable genotypes. More recently they have initiated studies to predict the effect of climate change on aflatoxin contamination.

Results

Using genomic and bioinformatics, these scientists have identified candidate genes in maize for resistance to aflatoxin contamination that can be used for either marker-assisted breeding or transgenic approaches to develop resistant lines. In a similar example, NCA&T researchers evaluated a number of cowpea varieties for various traits to assess the impact of biological constraints including insects and disease. Cowpea, a versatile legume, is a critical crop for small growers, which account for 90% of the state?s farmers. The results of this research have produced new knowledge on pest disparity between ecological zones with respect to incidence and composition. This will guide in the development of appropriate management tactics tailored to each location.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Diseases and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

Increased profit through the adoption of new production practices *and marketing locally*

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3250000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina?s tobacco market has declined significantly since 2004, leaving farmers with the need for new, high-value profits. At the same time, due to rising food costs, concerns over food safety and a desire to know where their food comes from, consumers are interested in purchasing more of their food locally. Supporting the purchase and distribution of local food is essential to sustaining local agriculture and growing the local food economy.

What has been done
North Carolina Cooperative Extension in Lee, Moore and Richmond counties, with its partners, has fostered Sandhills Farm to Table, an innovative cooperative local food hub that has pioneered access to local farm produce by local consumers. As Sandhills Farm to Table enters its fifth season, it is operationally profitable. In Lee County, for example, nearly 2,000 produce boxes were distributed, resulting in $40,000 in sales. In total, the hub distributed fresh produce boxes to 1,100 households. However, this market is considered mature, with sales unlikely to expand beyond $570,000 annually. To continue growing the food hub, Cooperative Extension worked with a number of partners to secure funding and build the cooperative?s capacity.

Results
After a slow start in 2013, during which less than $15,000 of produce was delivered to institutions, the cooperative increased sales nearly sixfold in 2014 to exceed $85,000. The cooperative plans to expand this business in 2015 to achieve a sustainable business level of $500,000. With letters of support and the offer of land from county managers, Cooperative Extension has submitted a $1 million grant proposal to expand Sandhills Farm to Table?s capacity to deliver local foods to local markets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #10

1. Outcome Measures

New organic, farmers and agritourism markets established by individual entrepreneurs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	741

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increasingly families are approaching North Carolina Cooperative Extension for assistance in learning how to use the land and other resources they have not only to make food for their families but also to make a profit.

What has been done
Members of an Iredell County family approached a North Carolina Cooperative Extension agent about how they might use 10 acres. The agent advised them on all aspects of starting an agricultural business, including production, planning, management and marketing. The agent also encouraged them to attend a farm school to learn to create a business plan and to visit other farms to get first-hand accounts of what works and what doesn?t.

Results
Family farmers completed the Piedmont Farm School and received certification of fresh produce Good Agricultural Practices. They also created a kitchen that is certified for baking to enhance income and sell farm products at local markets as well as at an on-farm roadside stand. Their farm now has an agritourism walking trail that includes educational activities to help the general public and school groups learn more about agriculture.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

Outcome #11

1. Outcome Measures

Growers Adopting Improved Business Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	20000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The average farmer in North Carolina is 57 years old and looking forward to retirement. We need new farmers to meet the demand for locally grown food in North Carolina. Many families are looking at ways to supplement their incomes and put their land into something productive. And many new farmers do not have the business or marketing skills needed to start a new business enterprise. This leads to costly mistakes and often failed farm business.

What has been done
In recent years, more and more farmers have been asking North Carolina Cooperative Extension how to farm or how to grow new crops. But knowing that there?s more to farming than production skills, Extension agents began organizing farm schools that focused on the business side of agriculture. Today, those schools operate under the umbrella North Carolina Farm Schools. In 2014, more than 80 farmers participated in class sessions and field days associated with three farm schools, learning about business management and planning, as well as marketing skills that are key to long-term success.

Results
More than half of the students participated in a final class survey, with the following results: 86% indicated that they refined their business plan; 97% said they will be able to avoid financial mistakes as a result of what they learned; and 76% said they learned marketing techniques that will increase their profits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

602 Business Management, Finance, and Taxation

604 Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Rapidly changing environmental and economic conditions (weather extremes, economic climate) influence producers' abilities to adapt to change while ensuring sustainable production systems. Continued effects of the economy on federal, state and local support for research and extension programs continue to challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension oppportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental, social and quality of life benefits.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Outcomes and impacts determined from our research and extension programs support the principle that our programs engage a wide array of users across the state, help support enterprise and marketing change (feed grains initiative), involve integration of research and extension efforts, and create significant economic value to the state in terms of added value from innovations in agricultural production, costs saved and enhanced marketing approaches. In addition, our research and extension enterprises represent productive environments in which our faculty are productive in terms of peer reviewed publications and creation of intellectual properties.

Key Items of Evaluation

We are continually challenged to keep evaluation principles and tools aligned with plans of work, program implementation practices in the field, and outcome observations so that we can effectively report the results of our efforts. We are proud of the many accomplishments of this program. A couple examples:
The swine industry, NCSU, NC Department of Agriculture, NC Biotech Center collaboration that spent over $1 million for research and education to stimulate feed grain production. Not counting increased corn and wheat production, additional grain from sorghum, which was promoted in the program, in just one year was worth an estimated $33

million. Including increased corn and wheat production has increased the value of this effort even more.

Our plant breeding programs for sweet potatoes and peanuts have a record or generating new varieties that become the predominant varieties used by the industry in a matter of just a few years after release. 'Covington' sweet potato and 'Bailey' and 'Sugg' peanuts are three notable cultivars.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security - Animals and Their Systems, Production and Health

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	15%	10%	20%	30%
302	Nutrient Utilization in Animals	15%	10%	20%	20%
303	Genetic Improvement of Animals	15%	10%	17%	20%
307	Animal Management Systems	15%	15%	18%	0%
311	Animal Diseases	5%	5%	10%	20%
312	External Parasites and Pests of Animals	5%	3%	5%	0%
313	Internal Parasites in Animals	2%	20%	5%	0%
315	Animal Welfare/Well-Being and Protection	5%	7%	2%	7%
404	Instrumentation and Control Systems	5%	0%	0%	0%
511	New and Improved Non-Food Products and Processes	3%	0%	0%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	5%	0%	0%	1%
601	Economics of Agricultural Production and Farm Management	4%	5%	1%	1%
602	Business Management, Finance, and Taxation	3%	5%	1%	1%
604	Marketing and Distribution Practices	3%	10%	1%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	60.0	6.0	105.0	8.0
Actual Paid	74.0	6.0	101.0	7.2
Actual Volunteer	60.0	0.0	40.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1307740	176710	1772520	668251
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1307740	150811	1772520	231499
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4761695	4913	12699000	29789

V(D). Planned Program (Activity)

1. Brief description of the Activity

This plan of work includes broad and extensive research and extension programs. NC Agricultural Research Service scientists will conduct research projects to study methods to improve the efficiency of animal production. Research will focus on methods to improve reproductive performance, nutrient utilization, and genetic influence on growth and reproduction. Scientists will also work to improve animal management systems, decrease the incidence of animal diseases and parasites (external and internal) and improve the management of animal and agricultural pests. Species and commodity groups included in this plan of work are also very broad and include poultry such as turkeys, broiler chickens, and table-egg chickens. The plan of work also includes swine, fish such as flounder, and cattle such as beef and dairy, and numerous pests such as house flies. Research will include many phases of commodity production such as meat and dairy goats, chicken breeders (both broiler and table egg birds), commercial broilers (commercial refers to those animals produced for meat), breeder turkeys, commercial turkeys, swine breeders, commercial swine, all phases of aquaculture and beef and dairy production. Disciplines that will be involved include nutrition, physiology, reproductive physiology, genetics, virology, bacteriology, microbiology, mycology, entomology, and many animal management systems such as grazing and forage management programs, hatchery management, feeding and drinking water systems, litter and bedding management, lighting programs, and breeder selection and management. A very important part of this plan of work is to transfer technology and knowledge to our stake-holders and clientele. Therefore, an extensive outreach effort through Cooperative Extension will be conducted by field and campus based faculty who are based on-site as well as being located across the state and based in local communities. Stakeholders and clientele will be directly engaged in many ways including workshops, conferences, discussion groups, one-on-one teaching, demonstrations, field days, short-courses, continuing education classes, and scientific meetings. Indirect methods to reach stake-holders and clientele will include long-distance education, newsletters, web sites, newspaper releases, television and radio programs, trade journals, scientific journals, and popular press articles. Participants and programs will be evaluated at least annually for success, progress, and effectiveness. Special educational programs focused on limited resource farmers will continue to be a priority for NCA&T focused Extension efforts in pasture based production systems, aquaculture and alternative breeds.

2. Brief description of the target audience

The target audience will be primarily aquaculture, poultry, livestock producers, small-scale limited resource, beginningand underserved growers and agribusiness personnel in North Carolina. However, since North Carolina producers are some of the best in the world, ultimately, producers and agribusiness personnel across the country and around the world will be the primary audience. In addition, the audience

will include personnel in other state and federal agencies, local, state and federal politicians, and other stakeholders including the general public.

3. How was eXtension used?

A number of animal systems Communities of Practice are available in eXtension, providing a valuable resource for production practices, animal health and management, and marketing. These resources are available to extensionists, producers and others supporting the food animal industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	249301	751608	51000	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014

Actual: 1

Patents listed

Methods for Gamete Production in Birds. 5051.497.JP2

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	87	312	399

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities to be conducted

Year	Actual
2014	1330

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2014	100

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Additional income gained by animal producers improved planning, marketing, and financial practices
2	Net income increased by producers improving animal husbandry practices
3	Number of animal producers adopting improved animal husbandry practices
4	Number Livestock Producers Adopting and Applying Improved Planning and Financial Management Practices
5	Number of new technologies developed to prevent/treat animal diseases
6	New organic, farmers and agritourism markets established by individual entrepreneurs

Outcome #1

1. Outcome Measures

Additional income gained by animal producers improved planning, marketing, and financial practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2010, the Canadian government implemented regulations regarding importations of fish into Canada resulting in a sizeable economic burden to the many North Carolina hybrid striped bass producers that sell their fish to Canada.

What has been done
After years of negotiations between the United States and Canada, the United States Department of Agriculture (USDA) Animal and Plant Inspection Services (APHIS) developed a registration program that satisfied Canadian importation requirements. The North Carolina Cooperative Extension Service area aquaculture agent, responsible for aquaculture educational programs in the northeast part of North Carolina, as part of his educational program, developed a standard operation procedure (SOP) document for the HSB producers to utilize when registering their farms with USDA APHIS. This SOP document was used in the successful registration of the first fish farm to export to Canada and will serve as a template for other farms in North Carolina and the United States.

Results
As a result of this program, the fish producers in North Carolina and the United States will save approximately $2,000 per export transaction going to Canada, amounting to savings of over $100,000 for the North Carolina producers alone.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. Outcome Measures

Net income increased by producers improving animal husbandry practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Most of the 5.8 million sows in the U.S. are fed to a subjective body condition target. Yet, visual sow body condition scores typically have low associations with estimated body composition. Developing accurate, cost effective tools to replace visual body condition scoring will allow pig farmers to optimize feeding levels while maximizing sow well-being, subsequent reproductive performance and profitability.

What has been done
An NCSU scientist worked with an engineer to create a prototype caliper that quantifies the angularity of a sow?s topline. The sow caliper design was completed based on data collected from commercial industry farms (Prestage Farms). A research project has been initiated with

Goldsboro Milling and Prestage Farms to identify the optimal sow body condition in relation to subsequent reproductive performance. Sow calipers have been distributed to farmers in nine countries worldwide and 10 U.S. states. Within North Carolina, Ivey Spring Creek Farms, JC Howard, Murphy-Brown LLC, Prestage Farms, Purvis Farms, Spring Meadow Farms, TDM Farms, NCSU Swine Teaching and Research Farm, North Carolina A&T and the NCDA Tidewater Research Station are using the sow calipers to reduce feed cost and improve animal well-being.

Results

The economic and societal implications of the sow body condition caliper are great. Farms that are overfeeding all or a portion of their sows will realize lower feed costs through the implementation of this new technology. Herds that contain sows that are too thin will realize improvements in sow well-being and subsequent reproductive performance. As a result of using the sow body condition caliper, one N.C. farmer experienced tremendous improvement in gestation feed usage across an 18,000 sow system. Since implementing the sow caliper in 2013 this farmer has reduced his feed cost by nearly $300,000 in both 2013 and 2014. Hence the development and implementation of the sow body condition caliper is significantly improving the profitability of pig farmers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #3

1. Outcome Measures

Number of animal producers adopting improved animal husbandry practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9437

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dairy producers in North Carolina can improve their farm profitability through effective use of reproductive and health management data. Numerous decision support tools and protocols are available in the industry, but all rely on effective input and storage of reproductive and related health data. Prior to 2014, the available means of capturing these data included paper, desktop herd management systems, and more recently, mobile systems such as PocketDairy designed for small, cell-phone size devices. No comprehensive cow-side portable software application was available to farmers.

What has been done
Dairy Records Management Systems (DRMS) received feedback from numerous farmers that reproductive management would be enhanced by using a more extensive view of individual cow data. The existing phone-sized PocketDairy application brought the data handling cow-side, but farmers requested that DRMS combine the PocketDairy convenience with the comprehensive view provided by their desktop applications. The DRMS development team designed and released Vet Check Maxx, the trade name for an all-in-one view of reproductive and health data combined with complete data entry capabilities.

Results
Since the introduction of Vet Check Maxx, DRMS has seen a steady increase in daily subscription levels, now averaging a net increase of 33 paying farms per month (approximately 50 additional users per month). The average herd size of the mobile user is 360 cows, so the mobile system is in use in the management of 328,000 cows. Vet Check Maxx received the ?Top 10 New Products? award at the World Ag Expo in February 2015, likely leading to increased farmer awareness of this system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #4

1. Outcome Measures

Number Livestock Producers Adopting and Applying Improved Planning and Financial Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9437

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With feed prices for livestock and horses at an all time high, producers are looking for ways to save money and help with feeding expenses. Eastern North Carolina producers wanted to graze and utilize their land in more ways but did not know how to accomplish that.

What has been done
Perquimans County Cooperative Extension helped seven producers with a total of 105 head of cattle save money by creating new and renovated pastures for the summer. Extension partnered with NCDA, and Soil and Water Commission to help establish grazing systems that would fit into each specific farm.

Results
Each producer reduced his feed bill by two-thirds and resulted in an average of 4,500 lbs of available forage per acre. This is an increase of 3,500 lbs per acre. This project worked on 120 acres with a total of 420,000 lbs of forage available, which saved the producers from buying 494 bales of hay. At a cost of $30 per bale, this resulted in total savings of $14,824. Also in 2014, NCSU?s Amazing Grazing program, a pasture-based livestock educational initiative, conducted producer-targeted summer grazing demonstrations and workshops in 10 North Carolina counties (and one South Carolina county) that attracted more than 670 producers. Amazing Grazing also conducted a national pastureland ecology course for NRCS grazing specialists from across the U.S.

4. Associated Knowledge Areas

KA Code	Knowledge Area

301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
311	Animal Diseases
312	External Parasites and Pests of Animals
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

Number of new technologies developed to prevent/treat animal diseases

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Commercial swine production facilities (CAFOs) house large quantities of animals at a single location. There exists the potential for catastrophic foreign animal disease. In the event of an animal related disease or a bio-hazardous outbreak, state and federal agencies must be prepared. Immediate and preemptive action is necessary to contain and eliminate further spread of disease. Systems currently used to euthanatize swine that rely on the handling and restraint of individual animals (as exists in most on-farm steady-state situations) will likely prove much too slow to stem the spread of disease. Increased public awareness regarding human health and public safety has stimulated research to develop, demonstrate, and evaluate innovative engineering systems and technologies that reduce or eliminate these potential problems.

What has been done
Research was conducted to determine the effect of pig euthanasia by carbon dioxide, CO2. This methodology has been extensively studied as a pre-slaughter stunning agent in swine and is an AVMA-approved agent for euthanasia of pigs. Final analytical results and research methodology have been prepared for final project reports, peer reviewed papers, and journal publications.

Results
A collaboration between NCSU and Murphy-Brown, LLC, has resulted in the development of a portable system for converting bulk liquid CO2 to gas and increasing its temperature to acceptable levels, before administering metered quantities for mass depopulation. In the next phase of this research, this system will be evaluated for utilization in cold climates and sub-zero seasonal weather conditions on large production swine CAFOs. This research will enhance the health status of the U.S. meat supply by anticipating and responding to new or emerging biosecurity hazards.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

New organic, farmers and agritourism markets established by individual entrepreneurs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is growing demand for pasture-based meats, and individual farmers face challenges scaling the supply for wholesale markets.

What has been done
Firsthand Foods, a company incubated by NCSU?s Center for Environmental Farming Systems, connects local livestock producers to local markets by delivering local, pasture-raised beef and

pork products to retail and specialty grocers, restaurants and direct to consumers.

Results

Firsthand Foods supports a network of 60 livestock producers and is expanding to regions beyond the Triangle area through new partnerships with companies like Foster-Caviness, a leading supplier of wholesale produce. In 2014, Firsthand Foods realized $1.25 million in sales, with 75% of revenues going directly back to the farmers and processors in its supply chain.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Constantly changing environmental and economic conditions (weather, economic climate, feed prices, regulatory climate) influence producers' abilities to accommodate change and innovation, while ensuring the sustainability of their enterprises. Economic pressures continue to influence federal, state and local support for research and extension activities. Regulatory and other governmental policies influence the educational and research capacities of our programs and present challenges to producers, processors, and marketers of animal products to comply with emerging and often expensive regulations. And in an environment of reduced appropriated funding, the program competition for existing funds becomes greater. Nevertheless, emphasis is placed on those research and extension opportunities which will have enduring benefits to farmers, their families, businesses, communities and their industries, in terms of economic, environmental, social and quality of life considerations.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of faculty activity reports, intellectual property creation (invention disclosures), peer reviewed journal articles, and data from our Extension Reporting System shows that

our research and extension efforts in this planned program area are successful in engaging a wide array of animal agriculture producers, processors and marketers. The data indicate that delivery of relevant research information and research backed production best management practices are associated with significant improvement in profitability of livestock and poultry operations. Faculty are successful in influencing individual producers as well as production companies that our research findings can generate additional profitability in their operations, sometimes with added environmental benefit. The information also demonstrates the research and extension programs at our institutions are creative environments for our faculty to be productive in making new discoveries, publishing in quality journals, and creating new business opportunities.

Key Items of Evaluation

Qualitative and quantitative data collected show that our efforts in this planned program area are having signicant benefit to users and to the state. Nevertheless, we are challenged to keep our evaluation tool kit in lockstep with the regularly changing research and extension needs. We will continue to refine our reporting and data collection system to most effectively collect data that represent the real world situation with respect to the impacts of our programs.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Climate Change

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%	40%	20%	20%
111	Conservation and Efficient Use of Water	5%	20%	5%	5%
112	Watershed Protection and Management	15%	10%	10%	10%
133	Pollution Prevention and Mitigation	10%	10%	10%	10%
141	Air Resource Protection and Management	5%	10%	5%	5%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	0%	5%	5%
402	Engineering Systems and Equipment	5%	0%	5%	5%
403	Waste Disposal, Recycling, and Reuse	10%	0%	10%	10%
404	Instrumentation and Control Systems	5%	0%	5%	5%
405	Drainage and Irrigation Systems and Facilities	5%	0%	5%	5%
605	Natural Resource and Environmental Economics	15%	10%	20%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	55.0	4.0	25.0	6.0
Actual Paid	68.0	2.5	24.0	1.8
Actual Volunteer	8.0	0.0	4.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1203121	108807	425805	277886
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1203121	23160	425805	86302
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4385359	5775	3050600	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research will focus on creating new knowledge and solutions from basic research (e.g., nutshell-based activated carbons), to agricultural production systems research, to natural resource pollution prevention strategies, to examining people's attitudes and concerns about environmental issues and policies, including economic considerations. With this research information in hand, improved management, technological solutions and policies to environmental and natural resource utilization problems will be proposed and evaluated with farmers, businesses, stakeholders and communities. Technology transfer will occur through demonstrations, workshops, and various media from Cooperative Extension in concert with researchers.

2. Brief description of the target audience

Agricultural producers, environmental and governmental agencies, news media, general public, limited resource audiences, rural appraisers, commodity associations

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	51435	61866	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2014
Actual:	1

Patents listed
Novel Methods and Compositions to Evaluate and Determine Inactivation of Hazardous Biological Material. 61/969,465

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	18	73	91

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Waste Management Certification Programs

Year	Actual
2014	10

Output #2

Output Measure

- Number research project completed on environmental/natural resource issues

Year	Actual
2014	95

Output #3

Output Measure

- Number of non-degree credit environmental activities conducted

Year	Actual
2014	400

Output #4

Output Measure

- Enrollees for Natural Resources Leadership Institutes training

Year	Actual
2014	20

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of farms utilizing precision application technologies
2	Number farms implementing best management practices for animal waste management
3	Number urban households/small farms with low-literacy individuals implementing or adopting best management practices to enhance water quality
4	Number waste management certifications gained or maintained
5	Number acres where proper waste analysis was used for proper land application
6	Number growers implementing stream protection practices
7	Number storm water systems installing BMPs
8	Number farms adopting use of biofuels
9	Number growers implementing improved irrigation and drainage systems

Outcome #1

1. Outcome Measures

Number of farms utilizing precision application technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The next generation of precision agriculture technology ? Unmanned Aerial Systems (UAS) ? could have dramatic impact on grower productivity statewide.

What has been done
Scientists in NCSU?s Biological and Agricultural Engineering Department are exploring applications of UAS in precision agriculture and environmental engineering. Evaluation of the aerial platforms and sensor payloads available are underway. UAS offers a wide range of sensor options, many of which are not currently available to agricultural producers on a routine basis.

Results
This research could result in the ability to fly over agricultural fields on demand, capture data, and make management decisions on crops with a short turnaround time (unlike satellites and manned aircraft, which take longer). Drones will allow greater flexibility with data collection and create opportunities that aren?t currently available, potentially improving precision agriculture practices statewide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

Number farms implementing best management practices for animal waste management

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1974

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The ammonia in manure and waste treatment systems is dilute and therefore limited in use to relatively short distances, usually on the same property on which the animals are raised. In North Carolina and much of the country, this prevents use of the valuable nutrients in the feed production system.

What has been done
NCSU engineers have built a pilot scale ammonia recovery reactor system based on technology developed by USDA-ARS that can remove 50% of the total ammoniacal nitrogen in a lagoon sample over a period of several days. In cooperation with ARS, these scientists will develop procedures that will facilitate on-farm operation.

Results
Development of this technology will help convert the pollution potential of liquid manure application into a valuable fertilizer product that can be transported out of the local watershed. Once developed, this technology will provide business and employment opportunities in many rural communities associated with animal production. Statewide, 1,974 animal producers adopted Extension-recommended best management practices for animal waste management, utilizing 2.4 million tons of livestock organic byproducts. By using livestock organic byproducts instead of synthetic fertilizers, growers statewide realized a net income gain of $35 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area

102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management

Outcome #3

1. Outcome Measures

Number urban households/small farms with low-literacy individuals implementing or adopting best management practices to enhance water quality

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers use excessive tillage and do not implement agricultural practices that increase soil carbon content.

What has been done
Reduced tillage practices, the application of compost and the growing of summer and winter cover crops are being evaluated by NCA&T scientists as practices that sequester carbon and increase soil carbon content.

Results
Field experiments have been implemented and soil samples collected for determining stability of soil carbon fractionation and analyses. Laboratory analyses are being conducted to determine carbon fractions and fraction stability.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #4

1. Outcome Measures

Number waste management certifications gained or maintained

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1895

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Animal waste management is a large part of livestock production in Bladen County. Producers must comply with many rules and regulations to protect the environment. Swine farmers must comply with conditions in their permit to stay in compliance with the Division of Water Resources.

What has been done
Bladen County Cooperative Extension provides assistance to swine producers, poultry producers and septic tank owners on sludge management, irrigation calibration, litter calibration, record-keeping, manure sampling, general permits and nutrient management plans.

Results
Extension helped 14 producers perform sludge surveys on 31 lagoons and seven producers calibrate equipment systems, which saved these producers almost $9,000. Additionally, 200 acres in Bladen County are now under nutrient management plans to ensure they are protecting the environment. Statewide, 1,900 waste management certifications were gained or maintained due to Extension education efforts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management

Outcome #5

1. Outcome Measures

Number acres where proper waste analysis was used for proper land application

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1041537

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Poultry production is North Carolina's largest agriculture sector, accounting for 35.8% of total cash receipts. Commercial poultry production results in large volumes of manure and bedding material, referred to as poultry litter. While litter is a waste byproduct to poultry growers, crop farmers can utilize litter as an excellent fertilizer, thus reducing or replacing their use of commercial fertilizers, usually at a cost savings. Waste management plans are required by General Statues to protect water quality, and they help farmers to utilize the nutrients in the litter to maximize benefits for the crops.

What has been done
Extension delivered waste management plans for new and expanding growers in four counties. Producers were trained in proper record keeping, sampling and handling regulations to protect water quality and maintain compliance with the NC Division of Water Resources.

Results
As a result of these efforts, 22,500 tons of litter these farms generate should be utilized to maximize crop production and preserve water quality. Statewide, Extension-recommended waste analysis was used for proper land application on more than 1 million acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #6

1. Outcome Measures

Number growers implementing stream protection practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	124

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sedimentation of streams, lakes and other waters in North Carolina is considered to be the state's primary pollutant. Population growth brings more urban areas, increasing storm water volumes and velocities delivered to smaller local streams eroding the stream banks, the primary source of the sediment. Traditional methods of stream-bank stabilization (walls, rip rap, gabion baskets, etc.) are failure-prone.

What has been done
Working with state and county environmental agencies, Extension specialists, city-town officials, environmental groups, property owners, landscapers, and Triangle J Council of Governments, a statewide team of Extension agents developed and delivered hands-on workshops in Wake and Durham Counties during 2012-2014 reaching over 100 participants in workshops and an additional 17,113 through photos and videos viewed on social media sites.

Results

Property owners, landscapers, environmental groups and city-town officials report implementing stream-bank stabilization practices saving over 725 tons of sediment annually from entering streams in Wake and Durham Counties. Other results: a property owner reported saving over $25,000 and 90 tons of soil by installing practices he learned at Extension workshops; 2 towns reported stabilizing over 1,200 feet of stream-bank: a landscaper avoided possible fines totaling over $50,000 by installing stream vegetation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #7

1. Outcome Measures

Number storm water systems installing BMPs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Rain water running off impervious surfaces creates flooding and pollutes the nation's streams and rivers. NCSU's Storm water BMP Inspection and Maintenance Training Program trains and certifies people to inspect and maintain practices such as wetlands, ponds, swales, and permeable pavement to prevent flooding and control pollution.

What has been done

More than 2,200 people have been certified in Storm water BMP inspection and maintenance and many return after 3 years to a recertification class to learn about new developments in storm water management. At the recertification class each person completes a survey to determine how many storm water practices they design, install, inspect, or maintain.

Results

Respondents reported the following practices under management: 383 bioretention beds retaining $828,000 of Nitrogen and $734,000 of Phosphorus; 1,702 ponds converting $1,752,000 of Nitrogen and $1,933,000 of Phosphorus; 179 wetlands retaining $1,769,000 of Nitrogen and $1,220,00 of Phosphorus; and 399 vegetated swales converting $985,000 of Nitrogen and $679,000 of Phosphorus. Additionally, in an example from Watauga County, Extension worked with the First Presbyterian Church of Boone to construct a stormwater wetland that captures and mitigates more than 8 acres of impervious surface. Extension was able to save the church $1,000 in vegetation costs by growing more than 500 plugs that volunteers planted throughout the quarter-acre wetland.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #8

1. Outcome Measures

Number farms adopting use of biofuels

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Agro-industrial residues and dedicated biomass crops contain complex carbohydrates that can be converted to high value products (e.g. food products, pharmaceuticals, biochemicals, biopolymers and biofuels). The development of biologically-based methods for converting and processing raw materials into higher value products that are cost effective and functional integration of processing/production steps along the supply chain (e.g. feedstock development, production systems, logistics, and end use) will increase the feasibility of using plant/crop based resources as additional feedstocks for consumer goods.

What has been done

The research program focuses on production of bio-based products, such as enzymes, biochemicals, and biofuels from agro-industrial residues and dedicated biomass crops. Several areas make up the program to address the diversity of renewable resources available and various processing methods that can be applied to generate products and enhance value, such as: semi-solid fermentation technology, enzymatic conversion methods and fermentation for development of effective biomass conversion processes, hybrid application of thermal and microbial conversion technologies for biofuel production from lignocellulosic biomass, and solvent extraction processes are also being investigated for biomass materials that contain natural colorants, nutraceuticals and other high value compounds.

Results

Other value-added products from the sweet sorghum crop have been demonstrated through ensliage and feedout studies and have shown promise as a near-term markets for the biomass crop as energy related applications gain momentum. Fermentation studies with adapted C. beijerinckii strain SA1 for butanol production using sugars derived from sweet sorghum and perennial grasses are providing key information for the next phase of ?advanced? biofuels. Anthocyanin compounds from the purple sweet potato can be extracted as a co-product of starch to sugar conversion. Among producers statewide, four growers adopted dedicated bioenergy crops on 49 acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies

Outcome #9

1. Outcome Measures

Number growers implementing improved irrigation and drainage systems

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improved drainage is essential for production of food, feed, and fiber in many parts of the U.S. including the midwest states and the coastal region of North Carolina. There is a critical need to sustainably maximize the productivity of drained land to meet the increasing demand for food and biomass for biofuel production. There is also a critical need to adapt agricultural production systems on drained land to predicted changes in the climate including changes in temperature and precipitation (amounts and timing).

What has been done
A variety of strategies and systems have been evaluated to enhance water control, drainage water management, and management of Nitrogen and Phosphorous export, as it relates to crop land and forest land.

Results
The research addresses local, national, and global needs, responds to emerging changes in land uses and management practices, and focuses on adapting crop production systems on drained lands to a changing environment. Specific outcomes include: 1. The development of the smart agricultural water management system including the automated drainage water control structure will lead to the revitalization of controlled drainage in eastern NC where large areas of agricultural lands are artificially drained. This will result in a potential increase in crop production, reduction in production cost, conservation of water, and substantial improvement in surface water quality. 2. The results of our research have shown that both controlled drainage and bio-reactor systems have the potential to be used as BMPs for reducing nutrient export from drained spray fields. Our research could lead to the adoption of these two practices by the state of North Carolina to reduce nitrogen losses to surface waters from land application of animal waste to drained fields. 3. The ongoing research on growing bio-energy crops will lead to a better understanding of the impacts of growing these crops on water quantity, quality, and C and N cycling. This is necessary for the evaluation of the sustainability of growing bio-energy crops on lands that are not used for food production. 4. The DRAINMOD suite of models are being used by many researchers in the U.S. and abroad to assess the long term effects of emerging changes in land uses and management practices on the hydrology and biogeochemistry of agricultural and forested lands with improved drainage. Models such as DRAINMOD are particularly essential at this time for predicting the response of agricultural and forest ecosystems to potential changes in the climate and assessing strategies for adapting agricultural and forest production systems on drained land to these changes in the climate.

4. Associated Knowledge Areas

KA Code	Knowledge Area

133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems
405	Drainage and Irrigation Systems and Facilities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Rapidly changing economic and environmental conditions influence producers' and communities capacities to adapt to change and at the same time, sustain their operations. Water supplies for irrigation, high cost of fuels, and harsh weather systems present significant challenges all too often. Changing federal, state local funding commitments for research and extension programs are challenged regularly. And regulatory and other governmental policies challenge the entire community, which our research and extension programs serve. Nevertheless, we are committed to ensuring that programs that endure are those that will have significant economic, environmental, social and quality of life benefits to our stakeholders.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Examination of the outcomes and impacts in this program area indicate significant progress and benefit in the areas of waste management, nutrient capture and utilization, and water quality protection, along with some of the economic benefits that accrue to those outcomes. As pressures increase for access to large quantities of irrigation water, it is anticipated that our research and extension programs will need to play a greater role in providing technology and systems to manage that water efficiently to optimize crop and food production, use nutrients efficiently and conserve water.

Key Items of Evaluation

Our strong programs in water quality and animal waste management and utilization continue. Our evaluation approaches are not collecting sufficient data and information on outcomes and impacts from our research and extension on irrigation and drainage systems and their benefits to farmers, communities and other land managers. We will strive to make changes in our evaluation tools to capture that information.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Energy including Biotechnology

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources	15%	0%	15%	20%
205	Plant Management Systems	15%	0%	20%	20%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	0%	5%	0%
402	Engineering Systems and Equipment	20%	0%	20%	20%
403	Waste Disposal, Recycling, and Reuse	20%	0%	15%	20%
404	Instrumentation and Control Systems	10%	0%	10%	0%
511	New and Improved Non-Food Products and Processes	15%	0%	15%	20%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	7.0	0.0	10.0	5.0
Actual Paid	8.0	0.0	10.0	6.8
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
156929	0	159319	507562
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
156929	0	159319	308574
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
572000	0	1141400	1205622

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Developing productive efficient systems to profitably produce a variety of crop and forestry based substrates for biofuels production
• Developing engineering solutions and systems to efficiently convert raw materials into useable fuels
• Exploit bioprocessing systems to produce a variety of compounds thatmight have utility in processing and manufacturing processes
• Advance or knowledge of energy use and conservation in human, agricultural, animal and processing environments
• Communicate solutions and systems to users through extension education and demonstration activities
• Further study of cattails as a feedstock for biofuels

2. Brief description of the target audience

Scientists, commercial and limited resource farmers, regulatory entities, homeowners, general public, agribusinesses

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1560	4562	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	10	47	57

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies on producing agricultural and forestry substrates for biofuel production

Year	Actual
2014	10

Output #2

Output Measure

- Studies on engineering conversion processes for biofuels and other components

Year	Actual
2014	20

Output #3

Output Measure

- Educating homeowners, growers and processors through workshops and other group educational approaches on sustainable energy topics

Year	Actual
2014	1842

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New crops or other biofuels substrates identified
2	New bioprocessing technologies developed
3	New bioproducts identified
4	Number of households improving energy conservation measures
5	Installation of energy saving strategies on animal and crop production facilities

Outcome #1

1. Outcome Measures

New crops or other biofuels substrates identified

2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers in North Carolina are in need of a promising biofuel feedstock crop that can produce biomass using swine waste.

What has been done
Growth and yield of the Giant Miscanthus (GM) grown with the application of swine waste was studied over a period of two years by NCA&T scientists. Observations were recorded on biomass yield from plots applied with fertilizers and swine waste.

Results
Swine waste applied at a uniform rate produced GM yields with good utilization of nitrogen and quality biomass. Timing of harvesting appears to be important. Early harvest (H1) produced significantly higher yield than later harvest (H2). This could be due to the fact that GM transports and stores much of its nitrogen in the rhizome during winter months for utilizing in the spring months. The moisture content of biomass harvested later in H2 is lower than H1 biomass and therefore easier to handle in terms of transporting and processing to bioenergy and biofuel processing plants. Overall, the results show that GM is a promising biofuel feedstock crop for NC farmers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems

511 New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

New bioprocessing technologies developed

2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Various conversion technologies have been used to produce biofuels from perennial grass. Despite advances in technology, the ability to produce biofuel as a single source of revenue remains infeasible; alternative applications are necessary. The application of an integrated green biorefinery has the potential of processing green grass into multiple product streams such as biofuels, proteins and valuable bioproducts.

What has been done
In NCA&T labs, freshly harvested Giant Miscanthus culm was reduced in size by a chipper/shredder and then pressed and separated into green juice and solid cake, using a Carver laboratory press. The solid cakes were then pretreated with hot water. The resulting hot water pretreated GM cake was used for the production of bioethanol through a simultaneous saccharification and fermentation process and the nutrient rich juice was used for microalgae cultivation.

Results
The results showed that liquid hot water pretreatment and the subsequent simultaneous saccharification and fermentation processing of Miscanthus could be an effective way to produce bioethanol. The results also showed that the green juice could be a highly nutritious source for microalgal culture. NCSU scientists also are investigating lignocellulosic feedstocks like miscanthus and switchgrass to understand how treatment of the biomass with alkaline chemicals changes the chemistry of lignin. They also are researching how interaction of biocatalysts (enzymes) crucial for converting carbohydrates (cellulose and hemicellulose) to sugars with lignin

limits their catalytic function. Understanding the fundaments of the lignocellulosic conversion process and the mechanism by which enzymes help to produce sugars can allow researchers to develop processes that are more economically and functionally feasible. Knowledge of the inhibition effect of lignin on enzymes can be the basis for developing enzymes that are more robust.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

New bioproducts identified

2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Algal biomass consists of three major components of carbohydrates, proteins and lipids. The mass fractions of these three constituent components in algae (and their potential commercial importance) depend on the algal species and cultivation conditions.

What has been done
A simultaneous saccharification and fermentation process was developed by NCA&T researchers to produce ethanol from the algal carbohydrates. The ethanol under a supercritical condition was used for the simultaneous extraction and transesterification of the algal lipid into biodiesel. Meanwhile, a thermochemical process was used to produce organic fertilizer from the solid microalgae residue in which the N and P have been enriched after the removal of carbohydrates and lipids.

Results
A biorefinery was developed to produce three bioproducts of ethanol, biodiesel and organic fertilizer from wet algae.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Number of households improving energy conservation measures

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1506

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Because of soaring home energy costs from the past several years, homeowners are looking for ways to reduce their energy usage and cost while seeking ways to help our environment.

What has been done
Energy conservation workshops were held at four Durham County branch libraries. Conscientious homeowners seeking to gain knowledge about the energy inefficiency and waste particular to their individual homes participated in one of the energy educational workshops and subsequently followed through with home energy assessments and correctional energy retrofits offered through Extension's E-Conservation program.

Results
Results from the combined E-Conservation workshops and the home energy assessments followed up with individual home retrofits averaged each homeowner a savings totaling $27.50/

month on energy costs, averaging a cumulative reduction of $11,550, along with an annual collective reduction of 41 metric tons of carbon emissions. Statewide, nearly 500 participants of Extension programs reported that they engaged in best management practices related to energy conservation, resulting in $49,000 in energy cost savings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

Outcome #5

1. Outcome Measures

Installation of energy saving strategies on animal and crop production facilities

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy costs for electricity and curing fuel for tobacco represent one of the highest expenses for tobacco growers, second only to labor expense.

What has been done
Cooperative Extension has educated growers on methods to reduce curing costs and to increase fuel efficiency at meetings, in newsletters, and one-on-one visits. In 2014, an on-farm testing was conducted in Johnston County on seven new curing barns, one existing older barn, and four barns with heat recovery and recycling systems. A field day was conducted at this site in the fall, and many growers are using the data that was generated to make new barn purchase decisions.

Results
Grower surveys show that 1,350 curing barns now use automatic ventilation controllers in Johnston County. These controllers reduce fuel consumption by an average of 40 gallons of propane per cure. It is estimated that each of these barns cycled at least 8 times during 2014 representing a potential fuel savings of 432,000 gallons of fuel valued at over $583,200. Additionally, research data is encouraging farmers to update barns to newer, more efficient

models with 115 new barns purchased in Johnston County over the past two years. These new barns reduce fuel consumption by approximately 15% when compared to the barns replaced.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Economic and environmental considerations related to energy use, sources and conservation continue to present challenges to both producers and users of energy. North Carolina's bioenergy research efforts have focused on developing biomass sources and processes suitable for capturing biofuels from those materials. That has been a slow process, even though plant breeders and agronomists continue to work toward prolific and productive plants to produce biomass. Energy conservation in homes and business continues to get some emphasis, especially as it relates to solar energy. And some of our research and engineering efforts have targeted energy use in both cooling and heating livestock and poultry buildings, with some success with solar approaches for heat and geothermal processes for cooling. Considerable opportunities may exist for continued impact in these areas.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Our research support base is modest, but nevertheless, our scientists and extension workers in this area have demonstrated the capacity to acquire external grants, publish their work in peer reviewed journals, and generate new processes and products. Plant breeders and agronomists have been successful in developing new cultivars of biomass producing grasses for potential biofuels production. Process engineers have made progress in solving some of the challenges to producing cellulosic ethanol, though commercial applications are not in operation in the state. One recent challenge was defunding by the state of the North Carolina Biofuels Center, which provided significant funding for biofuels research, although a portion of the funding was restored through another agency. Continued opportunities may exist for exploiting this area, particularly in research of producing biomass and discovering processes to make production of cellulosic ethanol efficient.

Key Items of Evaluation

Tools to fully capture accomplishments in this field of science to be revised as we have indicated in other program areas.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Childhood Obesity

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	20%	0%	50%	0%
703	Nutrition Education and Behavior	30%	50%	30%	50%
724	Healthy Lifestyle	50%	50%	20%	50%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	10.0	12.0	3.0
Actual Paid	43.0	16.0	8.0	1.1
Actual Volunteer	80.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
758489	347135	142173	168815
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
758489	25001	142173	21509
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2760600	217433	500000	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Childhood Obesity Planned Program will provide science-based educational and experiential learning opportunities that focus on children, but actively engage an array of audiences--regardless of gender, income, age or race/ethnicity--because of the influence that these groups in society have on the health and well-being of themselves and their children. Programs developed and provided by NC Cooperative Extension in the area of healthy weight for children and adults is part of the larger initiative Eat Smart, Move More North Carolina. As a founding member of the movement, our programs are part of a larger effort to educate and change environments so that all North Carolinians have the opportunity to eat smart and move more. Important program activities include: **EFNEP**, the Expanded Food and Nutrition Education Program, is a federally funded educational program administered in North Carolina through NC State University and NCA&T State University. For more than three decades, EFNEP has been helping limited resource youth and families with children learn how to eat healthier meals and snacks, stretch their food dollars and reduce the risk of food-borne illnesses. The Supplemental Nutrition Assistance Program-Education (**SNAP-Ed**) serves limited resource families across North Carolina to assist those eligible for food assistance to eat smart and move more. SNAP-Ed works to help participants make healthy choices within a limited budget and choose physically active lifestyles. NC State University's SNAP-Ed Program is Steps to Health, which works with preschoolers, kindergarteners, 2nd grade students, 3rd grade students, and high school students. **Color Me Healthy**is a program developedto reach limited resource children ages four and five. Color MeHealthy uses color, music, and explorationof the senses to teach children that healthyfood and physical activity are fun. Agents train child care providers in the use of the program in their setting. **Faithful Families Eating Smart and Moving More** is a program that helpsfaith communities in North Carolina make and sustain changes that promote healthy eating and physical activity. **Eat Smart, Move More Weigh Less**(ESMMWL) is a weight-management program for adults. This 15-week evidence-based program includes strategies proven to work to achieve and maintain a healthy weight and encourages small changes that can be sustained over time. The program includes a family component to influence the eating and physical activity of all family members. **Cook Smart, Eat Smart** is a program that teaches simple, basic cooking for teens and adults. Eating more meals at home is an important strategy for eating a healthy diet. Cook Smart, Eat Smart provides hands on education on how to plan, shop, fix and eat healthy family meals.In addition to the methods mentioned earlier, social media tools will be used by researchers as a means of helping to reinforce information about healthy eating and physical activity behaviors among adolescents.

2. Brief description of the target audience

Intended audiences include children of all ages, youth, their adult family members, child-care providers, Head Start workers, food banks, food stamp and WIC recipients and community coalitions. No time is more critical than childhood to promote healthy eating and sound health practices. Children do not consume sufficient fruits or vegetables and have diets that are low in fiber and higher in fat than recommended. Children need quality nutrition education to help positively influence their food choices. For nutrition education efforts to be effective, they must also include parents and care givers. Helping families make informed decisions about their nutrition will help ensure that North Carolina's children grow to reach their full mental and physical potential. Overweight in children continues to rise. Treatment of overweight and obesity is difficult. Prevention of overweight and obesity in children is essential to address this issue. Demographic changes in the state's population continue to impact nutrition and health issues. The fastest growing age group is the 65 years and older segment, and the elderly have disproportionate risk of malnutrition and poverty, as well as poor overall health, and in many cases they are either care-givers or influence the care of children. Because of the influence that adults have with different age groups, and because of their own health concerns, healthy nutrition and well-being educational programs are important for adults as well. Programs addressed to young adults and middle-aged consumers will continue to impact the health of the population as it ages, but including children as well. Women are employed outside the home in greater numbers, and many of them are among the

working poor. Over 80% of women who had school-aged children were working outside the home; 67% of women with the youngest child under six years were in the labor force. For working parents with very limited resources, lack of after-school and summer programs for youth is a major concern, as it relates to nutrition, health, and obesity as well as other developmental needs of children.

3. How was eXtension used?

The Families Food and Fitness CoP of eXtension offers frequently asked questions, articles, online learning activities, and interactive tools on families, food and fitness topics. The CoP's aim is to become a source of reearch-based information for families as they work to eat smart, move more and achieve a healthy weight. The Families Food and Fitness CoP provides education and skills to help families make informed decisions about healthy eating and physical activity by providing them with science-based information and learning opportunties through eXtension.
Families Food and Fitness is organized around three goals:
-improved diets
-increased physical activity
-maintenance of body weight in a healthy range and avoidance of excess weight gain
The website content is focused on six key behaviors that have been identified in the literature to be associated with maintaining and achieving a healthy body weight:
-move more everyday
-tame the tube
-control portion size
-enjoy more fruits and vegetables
-prepare more meals at home
-re-think your drink

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	174650	135826	29730	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	17	4	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Non-degree credit group activities conducted Healthy Eating, Physical Activity and Chronic Disease Reduction

Year	Actual
2014	3686

Output #2

Output Measure

- Targeted audiences participate in workshops on Food, Nutrition and Childhood Obesity

Year	Actual
2014	126126

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Program participants (adults) increase fruit and vegetable consumption
2	Program participants (youth) increase their fruit and vegetable consumption
3	Program participants increase their physical activity
4	Program participant reduce their BMI
5	Program participants (adults) decrease blood pressure
6	Program participants (adults) improve their blood glucose (A1c.) level
7	Program participants (adults) reduce their cholesterol
8	Program participants consume less sodium in their diet

Outcome #1

1. Outcome Measures

Program participants (adults) increase fruit and vegetable consumption

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15691

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In North Carolina, about 66% of adults are overweight or obese. Twenty-seven percent of U.S. health care costs are related to obesity. Many limited-resource families struggle with food resource management, food security, meeting the nutritional needs of their family, and keeping food safe and nutritionally sound. Additionally, limited-resource families are at greater risk of chronic diseases associated with poor nutrition.

What has been done
The Expanded Food and Nutrition Education Program (EFNEP) helps food insecure families acquire the knowledge, skills and attitudes needed to manage food resources efficiently and to ensure nutritionally sound diets can be consumed on a consistent basis. In addition, EFNEP participants learn how to provide nutritious, safe meals for their families on limited budgets. EFNEP Nutrition Program Assistants enroll youth and families with children ages 0-19. In addition, EFNEP provides supplemental nutrition education through its social media including Facebook, You Tube, Google+, and blog.

Results
In 2014, 4,742 families and 27,230 school-aged youth participated in a series of EFNEP nutrition education classes. Statewide, nearly 16,000 adults increased fruit and vegetable consumption as a result of participating in Extension programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Program participants (youth) increase their fruit and vegetable consumption

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	21206

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Only one in four children in North Carolina eat recommended amounts of fruits and vegetables. According to the North Carolina Nutrition and Physical Activity Surveillance System (2012), 15.4% of the children ages 2-4 years old in Montgomery County are overweight or obese.

What has been done
In order to decrease health risks, Montgomery County Cooperative Extension taught the Color Me Healthy program 228 kindergarten and pre-k students. Teaching methods were interactive and designed to educate and facilitate behavioral change in the students; tests enhanced the multi-sensory learning experience.

Results
According to parent feedback forms, 93.2% of parents reported their child's improved willingness to try fruits, 85.6% reported an improved willingness to try vegetables, 91.7% reported an increase in their child's physical activity, and 66.7% reported observing other positive changes in their child regarding health. Statewide, nearly 21,000 youth increased fruit and vegetable consumption as a result of participating in Extension programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #3

1. Outcome Measures

Program participants increase their physical activity

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	25833

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nearly half of the children in North Carolina spend more than two hours watching television every day. The prevalence of food insecurity in North Carolina is higher than the national average, with 25% of children living in households that lack access to adequate food, and three of 10 kids in North Carolina relying on SNAP to meet their nutritional needs.

What has been done
Steps to Health provided nutrition education with the ultimate goal of promoting positive behavior change related to nutrition and physical activity. Six programs targeting preschool/kindergarten students, 2nd graders, and 3rd graders, adults, older adults and Latino/Hispanic families were provided at low-income sites in counties across North Carolina. New this year, steps were taken to assess healthy eating and physical activity environments, systems, and policies at Head Starts, schools, and congregate nutrition sites. Cooperative Extension agents used interactive teaching methods including lecture, discussion, games, worksheets, music, cooking demonstrations and taste tests, designed to educate and facilitate behavioral change.

Results
Steps to Health reached 6,193 participants (5,376 children and 817 adults) and made 46,520 educational contacts within 56 counties across North Carolina. Additionally, 100% of Head Start sites, schools, and congregate nutrition sites reported making a change in their environment and/or policies since a Steps to Health program was delivered at their site. Statewide, nearly 26,000 individuals increased their physical activity as a result of participating in Extension programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

Program participant reduce their BMI

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2761

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The issue of overweight and obesity continues to be the most pressing public health problem of our time. An estimated 50% of adults attempt to lose weight or not gain weight each year. North Carolina, like many other states, has a plan to prevent overweight, obesity and related chronic diseases. To achieve the goals of the state plan, accessible and affordable, family-based, culturally relevant, interdisciplinary weight management services for adults are needed. Local educators need educational materials that address weight management that are built on accurate content.

What has been done

The Eat Smart, Move More, Weigh Less (ESMMWL) weight-management curriculum was created by a team of professionals with expertise in nutrition, physical activity, and behavior change. Published research data were used to identify strategies that were associated with weight loss and/or weight maintenance. These strategies were used to create 15 Eat Smart, Move More, Weigh Less lessons. Since January 2011, the program has been delivered in a real-time, online environment. These classes are conducted by a live instructor using synchronous, distance-education technology.

Results

As of December 2014, a total of 216 ESMMWL online classes with 4,348 participants enrolled have been provided to members of the North Carolina State Health Plan. Statewide, nearly 3,000 individuals reported reduced Body Mass Index (BMI) as a result of participating in Extension programs. The ESMMWL program gained the attention of Blue Cross and Blue Shield of North Carolina (BCBS) as a possible way for them to expand their wellness offerings. The ESMMWL team continues to work with BCBS to offer the program as a covered as a medical expense. Plans are underway for the program to be fully covered by BCBS insurance in 2015.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #5

1. Outcome Measures

Program participants (adults) decrease blood pressure

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	741

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The leading cause of death in Craven County is heart disease. Cooperative Extension plays a big role in working with faith-based communities on this and other issues.

What has been done

Cooperative Extension and three faith-based communities collaborated to offer the Faithful Families program to their congregations. This program offered 38 families simple solutions to help them eat smart and move more. The program also provided families with skills to be able to prepare more meals at home. During each session, participants? blood pressures and weights were measured. The program is based on making behavior changes at home relating to healthy meals and physical activity, and participants are required to log weight and blood pressure.

Results

Weight loss and lower blood pressure are among the potential results. Additionally, all of the participating families learned new recipes, and the churches made two policy changes to improve the health of their congregations. Statewide, 750 adults reduced their blood pressure as a result of participating in Extension programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #6

1. Outcome Measures

Program participants (adults) improve their blood glucose (A1c.) level

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	225

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In western North Carolina the mean estimated percent prevalence of diagnosed diabetes among adults rose from 8.5% in 2005 to 9.0% in 2009 (2013 Graham County Community Health Improvement Plan). This is a major health crisis in the community, and hardly any diabetes education exists in Graham County.

What has been done

Graham County Cooperative Extension partnered with the Community Health Team, Graham County Health Department and the Graham County Diabetes Coalition to recruit a certified diabetes educator and registered dietician to create the diabetes support and educational class, Sugar Free. Program participants learned to count carbohydrates, meal plan, and manage Type II Diabetes through diet, exercise and medicine.

Results

Participants measured their glucose (A1c.) levels before starting the class and after participating in the class. Four participants reported lowered glucose (A1c.) levels. Two participants with Type I Diabetes reported a better understanding of their medicine and how diabetes affects their bodies. Statewide, 225 Extension program participants improved their blood glucose levels. Additionally, NCSU is part of a multi-agency team working with the N.C. Division of Public Health to develop an online portal to be used by primary health care providers. This portal would allow for referral of patients to resources in the community to help them live with chronic diseases including diabetes, heart disease, stroke, and obesity. It is proposed that Eat Smart, Move More, Weigh Less be the first intervention to test the portal.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #7

1. Outcome Measures

Program participants (adults) reduce their cholesterol

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2014	295

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity and related chronic diseases are prevalent among North Carolinians. The number one killer in Craven County is heart disease. Elevated cholesterol levels, overweight, waist hip ratio, and elevated blood pressures are all documented as risk factors for heart disease and stroke. Cooperative Extension has been on the front lines offering nutrition and wellness programs to Craven County citizens.

What has been done
Cooperative Extension and the Craven County Health Department collaborated to offer "Give Your Heart a Healthy Beat" twice a year. Twelve at-risk citizens attended 10 weekly sessions held at Carolina East Medical Center during 2014.

Results
As a result of the program, participants lowered their triglycerides levels by a group total of 374.5 points; cholesterol levels by 268 points; and weight by 35.8 pounds. Statewide, 295 adults reduced total cholesterol as a result of participating in Extension programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #8

1. Outcome Measures

Program participants consume less sodium in their diet

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5647

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the North Carolina State Center for Health Statistics, the two leading cause of death in Surry County are cancer and heart disease.

What has been done
In an effort to help combat this problem, the Nutrition Program Associate in Surry County has been using the EFNEP?s Families Eating Smart Moving More Curriculum to provide limited-income families basic nutrition information.

Results
Of the 83 families graduating from the program, 96% of participants showed improvement in one or more nutrition practice (i.e. plans meals, makes healthy food choices, prepares food without adding salt), and 100% of participants showed a positive change in any food group (fruits, vegetables, whole grains, etc.). Statewide, 5,647 individuals reduced the amount of sodium in their diets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Many factors affect individuals' decisions and abilities to practice positive behaviors with respect to healthy eating and physical activity. These factors include the physical and social environment of families, communities, and organizations; the policies, practices and norms within the social and work settings; and access to reliable information. Lasting changes in healthy behaviors require physical environments and social systems that support positive lifestyle habits. In order for individuals (adults and children) to make positive lifestyle changes with respect to healthy eating and physical activity, changes need to be made in the surrounding organizational, community, social and physical environments. Without these changes, successful health behavior change is difficult to achieve and sustain. Confidence in adopting and maintaining a behavior may be strengthened when the physical and social environment supports the new behavior. Policy and environmental interventions

can improve the health of all people, not just small groups of motivated or high-risk individuals. NC Cooperative Extension continues to work using the multilevel model or socioecological model for behavior change. It is within that context that we provide education to participants while working at the county and state levels to make systems, policy, and environmental changes. These changes are systemic and societal, thus do not happen quickly. Slow changes in policy and environments that support healthy eating and physical activity continue to challenge our ability to make improvements in eating and physical activity patterns.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Adults and youth alike made incremental changes in a number of health enhancing eating behaviors as well as physical activity (detailed in the state defined outcomes above). The educational programs supporting these changes are continuing, as additional opportunities exist for further advances in these lifestyle changes. The program will continue to stress that those individuals who make healthy food choices and are physically active are more likely to achieve and maintain a healthy weight and reduce incidence of chronic disease. Ultimately, this will lead to a reduction in health care costs, increased longevity, greater productivity and improved quality of life.

Key Items of Evaluation

Eat Smart, Move More, Weigh Less is a weight-management program that uses research-based strategies for weight-loss/weight maintenance. This 15-week program informs, empowers and motivates participants to live mindfully as they make choices about eating and physical activity. The program provides opportunities for participants to track their progress and keep a journal of healthy eating and physical activity behaviors.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety - Food Production Systems: Development, Processing and Quality

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	15%	0%	20%	25%
502	New and Improved Food Products	15%	0%	15%	30%
503	Quality Maintenance in Storing and Marketing Food Products	10%	15%	10%	20%
504	Home and Commercial Food Service	10%	20%	5%	0%
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%	25%	10%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%	40%	40%	25%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	54.0	5.0	55.0	6.0
Actual Paid	67.0	4.0	53.0	0.5
Actual Volunteer	10.0	0.0	4.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1176967	87903	921625	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1176967	6788	921625	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
4290000	64561	6602800	449681

V(D). Planned Program (Activity)

1. Brief description of the Activity

Multiple research and educational outreach programs will be conducted under the umbrella of improving the quality, safety, security, and nutrition of food products produced in North Carolina. Specific research projects will identify effective nutritional control strategies for replacement of growth-promoting antibiotics for improving gut function and reducing intestinal colonization and shedding of Salmonella; assessing the incidence, populations, serotypes, genotypes, and antibiotic susceptibility of Salmonella and Campylobacter fecal isolates as a function of farm, bird age, season, management practices, and strategic processing of commercial broiler, turkey, and layer farms; assessing novel antimicrobial strategies for use in reducing foodborne pathogens and biofilm formation on food processing contact surfaces; employing the antimicrobial properties of eggshell membranes for reducing the heat resistance of foodborne pathogens; development of Salmonella-specific inhibitory nanoparticles for preventing intestinal colonization; development of alternative layer molting diets for reducing the risk of Salmonella contamination of shell eggs; characterization of Campylobacter respiratory chain genes for use in developing rational drugs for controlling infection of food animals; conduct ecotoxicological studies to identify chemical pollutant sources that contaminate aquatic human foods; development of a high hydrostatic pressure system for reducing toxigenic histamine-forming bacteria in scombroid fish and vacuum and MAP packaged fresh tuna; develop a more efficient means of producing a high-gelling protein isolate from underutilized fish species and other meat sources that could replace surimi manufacture and improve the quality, sensory and yield characteristics of new and existing muscle food products; development of a Vienna sausage product without casings via an in-tube focused microwave field heating technology; improving the texture and yield of canned/pouched Albacore tuna by controlling precook proteolysis and injection of a tuna-derived protein isolate; application of continuous flow processing of foods and biomaterials using advanced focused microwave technology; and development and testing of tools, methods and devices for rapid sterilization and production of high quality vegetable and fruit purees; isolating, identifying and characterizing bioactive compounds from peanuts skin, sweet potato peels/flesh, pokeweed roots and rosehip fruits and wine grapes skins /seeds; developing value-added products incorporating bioactive compounds from select extracts and evaluating them for consumer acceptability; exploring industry partnerships for commercial utilization of prototyped products incorporating bioactive extracts; and isolating the most active fractions from pokeweed and rose hip that show strong antiproliferative and apoptosis activity against breast, colon, and cervical cancer cells. A very important aspect of this plan of work is to transfer technology and knowledge to our stakeholders and clientele, including efforts of the Plants for Human Health Institute's NC Market Ready and NC Fresh Produce Safety Task Force.

2. Brief description of the target audience

Primary food producers, food processors, foodservice operators, county extension agents, state and federal regulatory agencies, commodity associations, news media and consumers. The primary audience will be in North Carolina but will also extend to audiences in other states (state and federal agencies, local, state and federal politicians and other stakeholders).

3. How was eXtension used?

eXtension provides an array of plant and animal systems Communities of Practice that provide relevant information and strategies for producers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	42500	77775	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014

Actual: 2

Patents listed

Aptamers with Binding Affinity to Norovirus. 62/011,880

Methods and Compositions for Sequences Guiding CAS9 Targeting. 61/986,427

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	12	118	130

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Highly focused non-degree credit group training activities to be conducted

Year	Actual
2014	573

Output #2

Output Measure

- Relevant and impacts focused research projects to be conducted

Year	Actual
2014	60

Output #3

Output Measure

- Number of firms adopting quality and safety strategies

Year	Actual
2014	1439

Output #4

Output Measure

- Program participants trained in home food preservation

Year	Actual
2014	2390

Output #5

Output Measure

- Program participants trained in good farmer's market practices

Year	Actual
2014	328

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of program participants who successfully pass the food safety certification examination
2	Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops
3	Number of companies adopting new technologies
4	Number of new companies in food manufacturing
5	Number of food industry companies undergoing equipment and food safety audits
6	Number of new food products that industry can manufacture to improve health
7	Program participants certified in Good Agricultural Practices (GAPs) or Good Handling Practices (GHPs)

Outcome #1

1. Outcome Measures

Number of program participants who successfully pass the food safety certification examination

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1155

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Centers for Disease Control and Prevention (CDC) estimates that roughly 1 in 6 Americans (or 48 million people) get sick from a foodborne illness each year, resulting in 128,000 hospitalizations and 3,000 deaths. Food safety education is believed to be an integral part in preventing foodborne illness outbreaks.

What has been done
Cooperative Extension in cooperation with the local health department provided a ServSafe training course to 88 food service managers in Robeson, Columbus, Bladen, and Scotland counties.

Results
Statewide, 1,155 food service employees received ServSafe training and certification. ServSafe training has potentially saved food establishments approximately $3.75 million in costs associated with foodborne illness.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service

711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of participants completing National Seafood HACCP Alliance Education and other food safety HACCP workshops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	140

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the U.S., approximately 48 million people fall victim annually to foodborne illness. Two major contributing factors to foodborne illness are poor hygiene practices and contaminated food and beverages. However, the risk of foodborne illness is unlikely when food is handled safely from the time of receipt until service. Scotland County Schools Child Nutrition staff prepares and serves more than 5,000 meals daily.

What has been done
To address this training need, Scotland County Cooperative Extension provides an annual School HACCP (Hazardous Analysis Critical Control Point) training for the school child nutrition staff members. Topics include: proper hand-washing, purchasing and receiving, storage, thermometers, temperature, preparation, and service.

Results
After completing the training, 100% of the managers felt confident in proper hand washing procedures, employee safety practices, foodborne illness risks, procedures for purchasing, receiving and storing food and workplace safety. With the National Restaurant Association estimating the average cost of $75,000 per occurrence, the fourteen schools represented could potentially save the county a combined $1,050,000 by preventing a foodborne illness outbreak. Statewide, 132 program participants were certified in food safety HACCP programs, including National Seafood HACCP Alliance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #3

1. Outcome Measures

Number of companies adopting new technologies

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The study of CRISPR-Cas systems at NCSU and the development and implementation of new tools and technologies for applications in food fermentations and genome editing could have significant impact on a number of different industries worldwide.

What has been done
Technologies being developed at NCSU are being used for the formulation of sustainable foods (vaccination of dairy starter cultures used globally for the manufacturing of yogurt and cheese) and the development of new gene therapy tools for human disease. The scientific output of the laboratory has yielded 17 publications in 2014, including papers in Science, Nature, and Molecular Cell, as well as novel patented inventions that have garnered industry interest and national media coverage (scientific and popular press, including Forbes and the New York Times).

Results
A number of global industry presentations, including those to Fortune 500 companies (DuPont, GSK, Syngenta, GE) and start-up companies (Caribou Biosciences, AgBiome, Intellia Therapeutics, Precision Biosciences), have resulted in several companies seeking licenses from NCSU regarding these technologies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Measures

Number of new companies in food manufacturing

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	5

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mechanical extraction of raw crabmeat results in 300 percent higher yield, with substantially less labor input, than the current industry process of cooking, cooling and hand-picking crabmeat. Recently a patented method for restructuring raw crabmeat was issued to Shure Foods Inc, a fledgling North Carolina-based company. This novel, biotechnology-based, processing method may hold a key to re-opening markets for North Carolina?s beleaguered blue crab industry.

What has been done

NCSU researchers are partnered with Shure Foods to further develop and commercialize the technology and help the company transition from R&D to a sustainable business. The team is in mid-phase of a number of experiments designed to ensure consistent performance in restructuring, stability in storage, and maintaining consistent, desired quality attributes in transglutaminase treated raw crabmeat products.

Results

The expected outcomes should deliver technical solutions for insuring a robust, consistent process for commercial production of high quality restructured crabmeat products, leading to full commercialization, and thus revival of the blue crab industry in eastern North Carolina and the mid-Atlantic region of the United States.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Number of food industry companies undergoing equipment and food safety audits

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Entrepreneurs often need assistance navigating the regulatory framework and the food safety expertise to ensure safe products are manufactured. For some products, consultation with a process authority (an expert in thermal processing as deemed by the FDA) is required before products can be sold. Also, nutritional labeling, while not required for small producers, is often desired for product packaging.

What has been done

The Entrepreneurial Assistance Program seeks to help entrepreneurs or businesses in North Carolina and beyond ensure their food products are safe and meet regulatory guidelines. Food product testing for safety parameters and nutritional labeling are the two main services provided in conjunction with general advising and answering questions on the multitude of topics of importance to a food entrepreneur.

Results

In 2014, the Entrepreneurial Assistance program provided product testing and/or nutritional labeling services to approximately 459 customers, resulting in about 690 products tested and 507 products labeled. If an entrepreneur had to pay for a process authority consultant (approximately $1,500 per day) for each product tested instead of getting it tested with us (only $100 per product), the program has already saved entrepreneurs a combined total of $966,000 assuming a consultant would spend only one day on each product. In addition to saving entrepreneurs money, the Entrepreneurial Assistance Program also answers numerous questions pertaining to product testing, nutritional labeling, food safety issues or regulatory guidelines. More than 50% of the products we test and label are for customers are based in North Carolina, indicating that the majority of the economic impact of the program directly benefits the state.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Number of new food products that industry can manufacture to improve health

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Corn bran is an abundant byproduct from the corn milling process. It is a good source of both dietary fiber and phenolic antioxidants. Because the structural network of corn bran formed by the dietary fiber matrix physically blocks the phenolic antioxidants entrapped in the fiber complex from interaction with other molecules in the gastrointestinal tract, the bound compounds are only slightly bioavailable.

What has been done
Previous studies have demonstrated that microfluidization process could substantially improve physicochemical and antioxidant properties of corn bran. The objective of this NCA&T study was to correlate physiochemical and antioxidant properties of microfluidized corn bran with microfluidization parameters using the Response Surface Methodology (RSM).

Results
The results indicated that microfluidization treatment significantly improved corn bran's hydration properties and increased its antioxidant capacities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products

Outcome #7

1. Outcome Measures

Program participants certified in Good Agricultural Practices (GAPs) or Good Handling Practices (GHPs)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	924

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to nationwide foodborne illness data and the U.S. census statistics for North Carolina, there are approximately 291,000 foodborne illnesses, 1,732 hospitalizations and 42 deaths in the state annually. The Economic Research Service of the USDA estimated the cost of these illnesses, including medication, hospital visits, emergency room costs, hospitalization, chronic medical conditions, loss of productivity, disutility and unfortunately premature death, at $430 million-4.7 billion dollars annually for N.C., based on the current population. Much of the responsibility of producing safe food rests on processors and on the inspectors that ensure the processor is following regulatory guidelines.

What has been done
Working with FDA instructors and other faculty, NCSU trained approximately 191 state, federal and tribal inspectors in Food Good Manufacturing Practices, Conducting Acidified Foods Inspections, Conducting Low Acid Canned Food Inspections. In addition, an NCSU faculty member co-instructed and coordinated a number of Acidified GMP, Acidified Manufacturing and Better Process Control Schools, certifying 182 individuals.

Results
If the training provided to state, federal and tribal inspectors as well as industry can influence individuals to prevent a mere 1% of these illnesses, the impact would be 29,100 illnesses and $43-$470 million saved annually in the state of North Carolina. In addition, the NCSU assistance program has saved N.C. entrepreneurs a minimum of $1,009,500 in 2014, if each product would have only required one day of services from a private consultant.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (National public health problem)

Brief Explanation

Rapidly changing environmental and economic conditions influence producers' and food businesses' abilites to adapt to change while ensuring sustainable production systems and environments. Continued effects of the economy on federal, state and local support for research and extension programs challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competition for existing funds becames a greater challenge. Nevetheless, emphasis is placed on those research and extension opportunties that have the greatest effect on sustainability of farms, families and businesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The evidence of outcomes and impacts of this program area reported herein are derived from our Extension Reporting System, faculty activity reports and impact statements, and Office of Technology Transfer. The data indicate that our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that benefits their businesses. Based on the impact statements, publication records, intellectual property created, and effective outreach, especially with various food safety training and certification programs, the food supply continues to both safe and one that's evolving with new process and products. We continue to foster and lead change in this program.

Key Items of Evaluation

Note the role that faculty in this program area have in helping keep the state's population of food handlers and servers trained and certified. The tools to capture additional outcomes and impacts from this program area need some revision to realize the fuller benefit of this program to the interests of both food safety and innovations in food products and manufacturing.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Human and Community Development- Youth Development and Families

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
607	Consumer Economics	10%	5%	20%	10%
801	Individual and Family Resource Management	15%	20%	5%	0%
802	Human Development and Family Well-Being	25%	25%	5%	25%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%	15%	20%	25%
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	10%	0%	30%	15%
805	Community Institutions and Social Services	10%	5%	0%	25%
806	Youth Development	20%	30%	20%	0%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	77.0	15.5	8.0	5.0
Actual Paid	96.0	25.5	8.0	10.5
Actual Volunteer	115.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
1680498	636477	142173	767129
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1680498	302659	142173	168018
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
6123140	265628	1018580	76713

V(D). Planned Program (Activity)

1. Brief description of the Activity

The family-focused goals of this program will be addressed primarily through a series of workshops that focus on developing family resource management, investment in healthy housing practices, and effective parenting. The goals will be to teach consumers:

1. Family resource management, debt reduction, developing budgets and saving plans
2. To be inclusive of low to moderate income families and families headed by women
3. About reducing home hazards
4. Disseminate of research findings related to agencies/organizations serving limited resource families

Youth impact will be achieved by developing and testing an educational curriculum designed to help youth develop characteristics associated with positive youth development. This will be achieved through a collaborative process of teams of campus/field based youth development educators, 4-H and other community professionals and volunteers, and youth. Each team builds youth development professional practices and expands the impact of evaluations as they: 1) scan the environment and identify emerging focus areas representing educational needs; 2) design and deliver programs responsive to those needs; and 3) design and implement outcome and impact evaluation tools to report successes into the Extension Reporting System. Along with the development of the these programs and its curricula, an additional focus will be to develop strategies to increase access to 4-H programs in local communities, with the intent to build strong networks of individuals who can address the unique needs of the targeted audience.

Contributions to community development will be achieved through a series of research activities including: (1) a study to determine the challenges of new manufactured home owners in the site installation of the units and develop recommendations to the industry for improving the installation process; (2) development of a database of community-based organizations (CBOs) by location, program priorities, capacity and method of operation to encourage collaboration among CBOs, policymakers, businesses and development agencies; and (3) a study to define the critical factors that impact leadership development in rural areas that could lead to new or improved programs for developing future leaders and contributing to the sustainability of rural communities.

2. Brief description of the target audience

The target audience for the activities of this program includes individuals/family consumers, working poor, low to moderate income, minorities, women, homeowners, families with young children, limited

resource parents, caregivers, court-mandated or DSS referred parents, and grandparents raising grandchildren in North Carolina. Other audiences include youth, volunteers, stakeholders and youth development professionals "to create helping relationships, to enable youths to become responsible, productive citizens."

Stakeholders for this program include advocates of underserved populations, representatives of rural communities, policy makers, community based organizations, and the scientific community.

3. How was eXtension used?

Relevant eXtension Communities of Practice include: Family Caregiving, Financial Security for All, Better Kid Care, Military Families, and Home Energy. These sources provide valuable information for educators, volunteers, children and their families. The sites offer frequently asked questions, articles, online learning activities, interactive tools and webinars in the various subject matter areas.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	818239	1293023	170394	283834

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	41	46	87

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Educational workshops related to energy efficiency and conservation.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Educational workshops for family financial management skills.

Year	Actual
2014	374

Output #3

Output Measure

- Program participants (youth) assuming new/expanded leadership roles in the community

Year	Actual
2014	2660

Output #4

Output Measure

- Educational workshops for consumers related to parenting and caregiving skills.

Year	Actual
2014	465

Output #5

Output Measure

- Program participants (adult volunteers) serving in new or expanded roles within Extension and beyond Extension, including community boards and task forces

Year	Actual
2014	4955

Output #6

Output Measure

- Program participants (youth volunteers) serving in new or expanded roles with Extension, and beyond Extension, including community boards and task forces

Year	Actual
2014	3128

Output #7

Output Measure

- Program participants (youth students) gaining career / employability skills

Year	Actual

2014	123946

Output #8

Output Measure

- Program participants (youth students) gaining knowledge in STEM (Science, Technology, Engineering, Math)

Year	Actual
2014	93294

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants implementing basic financial management strategies (developing budget, keeping records, etc.)
2	Program participants actively managing their financial accounts and financial identity (such as; obtaining credit reports, choosing credit products, implementing identify theft safeguards, opening or selecting bank accounts, etc)
3	Program participants accessing programs and implementing strategies to support family economic well being.
4	Individuals, businesses, industries and governments engaging in best management practices related to energy use/conservation
5	Professionals using learned best practices with children/youth/adults, older adults
6	Program participants adopting positive parenting practices.
7	Youth Involved: Day Camps
8	Youth Involved: 4-H Clubs
9	Youth Involved: School Enrichment
10	Youth Involved: Special Interest
11	Youth Involved: Resident Camps

Outcome #1

1. Outcome Measures

Participants implementing basic financial management strategies (developing budget, keeping records, etc.)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2565

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The seriousness of today's economic climate has highlighted the importance of basic money management skills. Unfortunately, individuals and families often lack basic financial decision-making skills. Budgeting and record keeping are essential skills for individuals and families to master in order to begin forming a secure financial future. Programs focused on these areas help equip individuals and families with tools to better manage economic change that will occur throughout their lives.

What has been done
Family and Consumer Science Agents collaborated with county and state partners to conduct workshops, conference and other educational events addressing the importance of basic money management skills such as record keeping and budgeting. These outreach efforts are designed to equip individuals and families with the tools they need to better manage economic change throughout their lifespan.

Results
As a result of efforts, 2,565 individuals and families implemented basic financial management strategies and 7,288 people accessed programs and implemented strategies to support their family economic well-being.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being

Outcome #2

1. Outcome Measures

Program participants actively managing their financial accounts and financial identity (such as; obtaining credit reports, choosing credit products, implementing identify theft safeguards, opening or selecting bank accounts, etc)

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1359

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the Personal Financial Employee Education Foundation, financial literacy is not just about knowledge, even though comprehension is key to personal financial success. The most important part of financial literacy is to apply the knowledge by practicing good financial behaviors. People cannot build assets and achieve their financial goals without good financial literacy. It is vital for society to help empower individuals to be financially literate.

What has been done
Cooperative Extension partnered with several organizations to provide financial programs at Forsyth County Community College, Solid Rock Baptist Church and Belview Recreation Center, reaching 295 family members (youth, single parents, college students, and senior citizens).

Results
50% of the participants increased their knowledge of the budgeting process and said they would make and follow a realistic budget to meet their family's needs. 55% said that they would start tracking their money. 40% learned the importance of obtaining a free credit report. Overall, the program enabled participants to increase their knowledge about financial management and improve their financial and emotional well-being.

4. Associated Knowledge Areas

KA Code	Knowledge Area

802	Human Development and Family Well-Being
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #3

1. Outcome Measures

Program participants accessing programs and implementing strategies to support family economic well being.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	7288

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the Center for Home ownership and the Housing Authority of Winston-Salem, it can take up to five years before families are ready and eligible to purchase a home. Home ownership is a process that should not be taken lightly by families because there are requirements and responsibilities in purchasing a house. Many families lack the knowledge of using money wisely and they live from check to check. Financial education and budgeting is a must for families to increase knowledge, adopt and practice skills in budgeting.

What has been done
Cooperative Extension and Winston-Salem Federal Credit collaborated with the Housing Authority of Winston-Salem to provide four sessions on budgeting for needs and wants, steps in budgeting, budgeting with the H-Plan, how to save wisely and how to read and understand a credit report.

Results
Participants reported improved knowledge in the following areas: 80% in budgeting, 90% setting SMART goals, 90% in ways to reduce debt, 80% in saving money, and 80% in needs vs. wants. Participants also indicated an intent to set SMART financial goals by using the completed H-Plan(80%), separate needs from wants (60%), prioritize expenses before spending money (70%), take action steps to become more self-sufficient (70%) and become more of a money saver than a spender (100%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

Outcome #4

1. Outcome Measures

Individuals, businesses, industries and governments engaging in best management practices related to energy use/conservation

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1541

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy consumption in North Carolina for transportation and industrial, commercial, and residential uses will continue to grow as the population of North Carolina continues to increase. Continued economic development of the state will depend in part on development of state-based sustainably-produced renewable energy while improving energy efficiency and conservation to conserve all sources of energy to curb demand.

What has been done
Family and Consumer Science agents collaborate with state, county and local partners to conduct residential energy education programs through the E-Conservation Program. Agents use workshops, educational products and conferences to provide education, as well as provide consumer energy kits and energy assessments (using local auditors) to help reduce energy consumption in the home.

Results
As a result of efforts, 705 participants increased their knowledge about best management practices related to energy use and energy efficiency. Nearly 500 individuals used best management practices to reduce energy use and increase energy efficiency in their homes, business, agricultural industries or government.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #5

1. Outcome Measures

Professionals using learned best practices with children/youth/adults, older adults

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2393

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order to prepare Northampton County teenagers to effectively meet the demands of adult life, positive life skill development is needed. Teenagers need to learn the responsibilities, commitments, and roles involved in successful leadership.

What has been done
Leadership training, an essential component to success, was the focus of the Teen Leadership Program 2014. Halifax and Northampton County Cooperative Extension 4-H programs partnered to offer a 5-month leadership development program to area teenagers.

Results
67% of participants reported an increase in their own leadership skills including the ability to plan and lead activities on their own. More than 60 percent of participants also stated that they learned to help younger children feel like they were part of the group and how to handle camper discipline. 78 of the participants expressed a desire to assist with other 4-H workshops in the future. Throughout North Carolina 2,393 professionals used best practices with children, youth and older adults; and 1,681 professionals earned CEUs or other work-volunteer related credentials.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #6

1. Outcome Measures

Program participants adopting positive parenting practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2153

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Basic skills, socialization and educational motivation are first taught in the home. Many youth, however, grow up in environments that lack parental supervision and support. Quality time with parents is essential to building trusting relationships. The consequence of these circumstances is that youth may display anti-social behavior, disruptive behavior, school dropout and substance abuse.

What has been done
Family and Consumer Science agents are assisting in building strong families by educating citizens about positive parenting practices. Agents direct educational workshops, conferences, camping experiences, and other outreach efforts focused on developing parenting skills. These efforts address the importance of family time and identify real life concerns and issues facing parents.

Results
As a result of educational programs 8,712 youth and adults used effective life skills and 2,639 adults increased their use of identified community resources.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

Youth Involved: Day Camps

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9639

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina offers its youth and families a number of unique opportunities to discover the world through 4-H camp and educational programs, to learn 21st century skills, to serve their communities, to learn employment skills and to learn how to be citizen leaders.

What has been done
At three 4-H camps and conference centers spread out across the state, youth can participate in programs that range from traditional camping activities such as swimming and horseback riding to environmental education and creative writing. Camps are tailored for youth ages 5 to 17. Recent renovations to all of the camps include major structural upgrades and new facilities. All North Carolina 4-H campus are accredited by the American Camp Association.

Results
In 2014, 12,661 attended 4-H camping programs (9,639 in day camps and 3,022 in residential camps). The focus of the various activities included Healthy Eating, Preparing Youth for an Employable Future, Building Community Volunteerism, Developing Life Skills, and Achieving Academic and Educational Success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #8

1. Outcome Measures

Youth Involved: 4-H Clubs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	22858

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina 4-H is a youth organization committed to building citizen leaders with marketable skills to succeed in today's global society. By participating in 4-H clubs, youth are empowered to reach their full potential working and learning in partnership with caring adults.

What has been done
4-H clubs are helping build a healthier North Carolina by improving the lives of youth as well as empowering them to step up and make a difference in their communities. Healthy eating, food security, exercise, safety and positive choices about relationships and drugs and alcohol are all important factors addressed through 4-H programming.

Results
In 2014, 22,858 youth were involved in 4-H clubs. National positive youth development studies show that, compared to youth who don't participate in 4-H clubs, 4-H'ers are five times more likely to graduate college, four times more likely to actively contribute to their communities, three times more likely to be physically active and two times more likely to pursue careers in science, technology and engineering.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

Youth Involved: School Enrichment

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	139333

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Over the past decade, America has started to understand the magnitude of its dropout epidemic and take important steps to measure and address it. Educators, administrators, community leaders, policy makers and others have been active at the school, state, and national levels to ensure dropout prevention and recovery and college readiness are part of a comprehensive educational improvement strategy tailored to local conditions.

What has been done
In 2014, 139,333 youth participated in 4-H school enrichment programs in 3,551 classrooms throughout the state. That translates to 13% -- or 1 in 10 -- students participating in 4-H programs in their local classrooms. 4-H school enrichment programs are designed to fit the NC Essential Standards and are used to bring learning to life in classrooms throughout the state.

Results
Statewide in 2014, 101,319 youth increased their knowledge in STEM, 42,474 girls participated in 4-H STEM programs, 24,914 youth gained career/employability skills, 5,738 youth increased their knowledge of entrepreneurship, 8,028 youth participated in 4-H drop-out prevention programs, and 3,333 teachers were trained in 4-H STEM curriculum.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #10

1. Outcome Measures

Youth Involved: Special Interest

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	94677

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One in four North Carolina children faces hunger. According to the 2014 Kids Count Data Book, North Carolina ranks 34th in the nation in child well-being. North Carolina 4-H continues to promote health and wellness as one of its major focus areas in efforts to raise awareness of hunger.

What has been done
In 2014, 27,230 youth participated in 4-H EFNEP (Expanded Food & Nutrition Education Program) and 1005 reported positive behavior changes in one of more of the following areas: daily physical activity, healthy food choices, and food safety in preparation and storage.

Results
Statewide, 94,677 4-H youth were active in special interest activities. Also in 2014, 4-H'ers participated in more than 76,000 foods and nutrition activities/programs, and 21,206 youth reported increases in their consumption of fruits and vegetables.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #11

1. Outcome Measures

Youth Involved: Resident Camps

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3022

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
North Carolina offers its youth and families a number of unique opportunities to discover the world through 4-H camp and educational programs, to learn 21st century skills, to serve their communities, to learn employment skills and to learn how to be citizen leaders.

What has been done
At three 4-H camps and conference centers spread out across the state, youth can participate in programs that range from traditional camping activities such as swimming and horseback riding to environmental education and creative writing. Camps are tailored for youth ages 5 to 17. Recent renovations to all of the camps include major structural upgrades and new facilities. All North Carolina 4-H campus are accredited by the American Camp Association.

Results
In 2014, 12,661 attended 4-H camping programs (9,639 in day camps and 3,022 in residential camps). The focus of the various activities included Healthy Eating, Preparing Youth for an Employable Future, Building Community Volunteerism, Developing Life Skills, and Achieving Academic and Educational Success.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and

Communities

805 Community Institutions and Social Services

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (NC DPI Regulations)

Brief Explanation

North Carolina does not report youth activites under subject matter categories for camps, special interests, school enrichment and 4-H clubs. Instead all are aggregated to result in one number of total participants for these categories.
The national budget crisis and its trickle down impact on the state of North Carolina have affected some of the program efforts, impacts and outcomes. Until the economy rebounds more robustly, communities and families stay closer to home and are less inclined to participate in educational programs. Despite Extension's footing in communities, when parents struggle with family finances and employment, their youth are impacted.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of largely Extension Reporting System data indicate that significant numbers of youth as well as adults engage with educational activities in this program area. One challenge in reporting on this planned program is that a number of the outcome indicators are conflicted with one another. For example the same group of youth participants that are aggregated as indicated above may be associated with different outcomes such as volunteerism, building citizen leaders and gaining life skills. Many of the participants benefit from multiple programs, so similar or identical numbers of participants may be reported for different outcomes.
Nevertheless, it is clear that nearly a quarter million youth are documented, and likely more, as being engaged with the youth programs and receiving quality education and mentoring from their involvement.

Key Items of Evaluation

Note aggregation of participant data for different 4-H and youth activities. This program can benefit from more clearly capturing well-defined impact statements, as well as some revision in the Extension Reporting System's ability to capture outcomes and impacts.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Human Health, Nutrition and Well-being

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources	5%	0%	15%	15%
206	Basic Plant Biology	5%	0%	15%	0%
502	New and Improved Food Products	10%	0%	15%	25%
701	Nutrient Composition of Food	10%	0%	10%	25%
702	Requirements and Function of Nutrients and Other Food Components	10%	0%	10%	25%
703	Nutrition Education and Behavior	15%	0%	0%	0%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%	0%	5%	0%
721	Insects and Other Pests Affecting Humans	10%	0%	10%	10%
722	Zoonotic Diseases and Parasites Affecting Humans	5%	0%	10%	0%
724	Healthy Lifestyle	10%	0%	10%	0%
802	Human Development and Family Well-Being	10%	0%	0%	0%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	8.0	50.0	6.0
Actual Paid	12.0	0.0	47.0	6.2
Actual Volunteer	20.0	0.0	12.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
217956	0	833035	641350
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
217956	0	833035	50154
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
794400	0	20000000	273275

V(D). Planned Program (Activity)

1. Brief description of the Activity

Human nutrition, health and well-being research and outreach programs will include, but not be limited to, the concepts listed below:

The Plants for Human Health Institute at Kannapolis, NC aims to enhance the nutritional value of fruits and vegetables and related compounds to improve human health and prevent disease. One of their first major accomplishments, collaborating with the David H. Murdock Research Institute and a nationwide consortium, is the sequencing of the blueberry genome, a major fruit when fresh fruit consumption and antioxidants for health are considered. Associated with the Institute, the NC Market Ready outreach program will provide information to growers and marketers for business management, marketing, safety and production management to facilitate the introduction and production of new crops evolving from the Institute's research efforts. Studies examine ways to identify and control tick species that vector Rocky Mountain Spotted Fever. A novel approach involved an all-natural botanical insect repellant for both ticks and mosquitoes. Biochemical research is developing technologies to produce effective vaccines against insect vectored diseases. Biochemists are seeking to understand ribosomal RNA targets for antibiotics in an effort to understand why antibiotics lose their effectiveness, ways to enhance the effectiveness of existing materials and possibly find new antibiotics with enhanced effectiveness or new modes of action. Also researchers are looking at the various potential uses of biofilms associated with bacterial masses, including the possibility of inactivating biofilms associated with disease causing organisms, making them susceptible to existing or new antibiotics or other antibacterial compounds. Geneticists are seeking to understand relationships between genetic makeups of animals and based on that, how environmental influences (chemicals, toxicants, food compounds) might influence cancer development. Outreach with partner and interested life sciences communities, the food and pharmaceutical industries and peer scientific communities provides new technologies and scientific information which may become the basis of startup or existing manufacturing companies.

2. Brief description of the target audience

- Peer researchers and collaborators, including health care providers
- Food processors and manufacturers
- Farmers and growers
- Consumers
- Allied technical service providers and consultants to growers, processors and marketers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	218309	169730	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014

Actual: 4

Patents listed

1)Title: Use of [6]-Shogaol metabolites in the treatment of cancer; Inventors: Shengmin Sang, Huadong Chen, Yingdong Zhu; Status: utility patent application filed 12/19/2013

2) Title: Use of Date Pulp in Fermentation Process to Produce Nutritional Supplement Inventor: Salam Ibrahim; Status: Provisional patent application filed 3/14/2014

3) Title: "Microfluidization of Cereal Brans and the Use Thereof in Foods" Inventors: Guibing Chen, Julia Raddatz and Tao Wang; Status: utility patent application filed 2/28/2014

4) Peptide Aptamers that Bind to the REP Proteins of ssDNA Viruses. 5051.726.IN2

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	26	134	160

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Non-degree credit group activities conducted related to human health, nutrition and well-being

Year	Actual
2014	3686

Output #2

Output Measure

- Targeted audiences participate in workshops and demonstrations on human health, nutrition and well-being

Year	Actual
2014	126126

Output #3

Output Measure

- Conduct research projects related to human health, nutrition and well-being

Year	Actual
2014	40

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Identify and develop new food constituents or compounds that can benefit human health or nutrition
2	Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds
3	Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety
4	Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

Outcome #1

1. Outcome Measures

Identify and develop new food constituents or compounds that can benefit human health or nutrition

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Grape pomace (GP), a residue of grapes from wine industry, has great potential to serve as an antioxidant and dietary-fiber-rich ingredient to improve the nutritional value of food products. However, the particle size of GP may influence its health benefits and applications.

What has been done
Pomaces of four cultivars of grapes grown in North Carolina were collected, dried and processed into powders with four different average particles sizes. NCA&T scientists then evaluated the effects of particle size on functional properties.

Results
This research showed that reducing particle size of GP mechanically can improve the accessibility of polyphenol, which may increase the bioavailability of GP polyphenols when GP-containing food products are consumed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology
502	New and Improved Food Products
701	Nutrient Composition of Food
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Create new plant materials (germ plasm, breeding lines, cultivars) that contain health benefiting compounds

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In this era of diminishing returns for novel drug development and escalating costs for health care, plants and related natural products offer a 'final frontier' for new drug and health product discoveries. Plant-based medications (including functional foods) can offer safe, time-tested, efficacious alternatives to drugs, so that proactive consumers can take charge of health maintenance. Plant-derived bioactives, featuring multiple molecular modes of action, are far less likely to be overcome by a microbe?s ability to build up immunity, and they can provide a broad-spectrum potency unavailable through synthetic drugs.

What has been done

Research taking place at NCSU's Plants for Human Health Institute is dedicated to discovery of the natural, health-protective constituents inherent in edible plants, determination of the mechanisms of action in the human body, and, subsequently, development of concentrated, efficacious, unprecedented, and cost effective functional food ingredients and phytopharmaceutical components. Recently, researchers engineered development of protein-phytoactive stable functional ingredients for use in fortified foods that require long shelf life and portability (e.g. sports, NASA, Army), and demonstrated that consumption of the ingredients improved physical performance, weight management, and endurance. In addition, routine intake improved immune response in athletes compromised after sustained physical exertion. In a parallel line of research, scientists have developed hypoallergenic peanut protein ingredients (complexed with phytoactives) which offer promise for oral immunotherapy, and potentially for processing hypoallergenic food products.

Results

Preliminary outcomes have led to research partnerships with the U.S. Army and discussions with food companies with interest in adapting technology to consumer products, specifically for the performance athletics market, and for allergy concerns. Research leads particularly in the allergy arena are being pursued to address alternative protein allergies (milk, soy, egg). In the sports nutrition arena, the research thrusts have led to new partnerships with researchers at New Zealand company Plant & Food Research to combine forces to assess impacts on athletic performance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
206	Basic Plant Biology
502	New and Improved Food Products

Outcome #3

1. Outcome Measures

Research projects generate findings that impact the knowledge of and control of vectors that impact human health and safety

2. Associated Institution Types

- 1862 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Poultry is the number one food animal product associated with cases of Campylobacteriosis in humans. Campylobacter infections in humans tend to be self-limiting but the medical costs and associated costs due to missed work, etc., are staggering. This issue is very important to the industry as carcasses contaminated with Campylobacter are a zoonotic threat to consumers.

What has been done
NCSU scientists have been collecting samples on farm and attempting to identify patterns for infection and antibiotic resistance. Their goal is to identify risk factors for introduction of Campylobacter onto a farm, then develop mitigating practices to reduce the risk.

Results
Researchers have gathered much information and have raised awareness to this as a potential food-borne pathogen for the growers/workers as well as the consumers. This work is ongoing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #4

1. Outcome Measures

Research projects generate findings that impact the knowledge of prevention or curing of diseases influenced by interactions of genetics and the environment

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Apoptosis, or controlled cell death, is dysfunctional in cancer cells, which leads to an accumulation of unwanted cells that are unable to die. Current chemotherapeutic agents used to treat various forms of cancer induce cell death by re-establishing apoptosis. A major disadvantage of the current therapeutic strategy is that tumorigenic cells build resistance to these drugs because the therapies target proteins that have early entry in the apoptotic program. Consequently, combined approaches are generally used to increase effectiveness. Even with combination therapy, an astounding one in four deaths in the U.S. are due to cancer, suggesting that alternative therapeutic strategies are required to decrease the mortality rate of this disease. Procaspase-3 is the terminal protein in the apoptotic cascade that, once activated, commits the cell to undergo apoptosis. Currently there is no therapeutic strategy to directly activate procaspase-3 even though there is a large pool of inactive procaspase-3 in many cancer cells.

What has been done
Scientists at NCSU are studying the activation of caspases and other closely related proteins.

Results

By understanding how caspase-3 is formed and activated, it may be possible to design small molecules that activate it in cancer cells. Such compounds would represent new therapeutic methods for the treatment of cancer.

4. Associated Knowledge Areas

KA Code	Knowledge Area
722	Zoonotic Diseases and Parasites Affecting Humans
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Rapidly changing political, policy and economic conditions influence citizens' and businesses' abilities to adapt to change while ensuring healthful living and high quality life. Continued economic conditions affect federal, state and local support for research and extension programs, in some cases creating challenges to maintain productive and impactful programs. The regulatory environment often creates challenges for farmers, processors, handlers and food providers; often compliance is expensive and complicated, especially the required documentation. Nevertheless, successful operators develop strategies to comply to ensure that the food supply is safe and plentiful and the environment is protected. Emphasis will continue to be placed on those programs in research and extension that have the greatest effect on sustainability of citizens, families and businesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Data from our Extension Reporting System, faculty activity reports and impact statements, and Office of Technology Transfer were used to assess outcomes in this program area. Despite the challenges and influencers noted above, the data available indicate that this program is reaching suitable segments of the audience and that faculty are productive, when considering development of new technologies and publication records. We will continue to strive for a program that is relevant and productive for stakeholders and supports a creative and productive faculty.

Key Items of Evaluation

Efforts will continue to discover and develop natural products and other technologies to enhance healthy living, reduce disease and enhance nutrition, including developing new plants from which compounds to enhance health might be derived. Our faculty and extension reporting efforts can be improved to capture more concrete impacts of this planned program area.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
21206	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
5	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
99180	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
5	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
4	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
107000	Tons of feedstocks delivered.